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## Research Paper

# Formulation, Optimization and Characterization of Anhydrous Polyherbal Face Wash Tablets: A Sustainable Unit-Dose Approach

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## ABSTRACT

The present study was undertaken to formulate, optimize and characterize polyherbal face wash tablets as a novel, eco-friendly, portable and sustainable alternative to conventional liquid face wash formulations. The growing demand for herbal cosmetics and environmentally friendly personal care products has encouraged the development of innovative formulations that provide effective cleansing while minimizing environmental impact. The tablets were prepared by the direct compression method using herbal ingredients such as Neem leaves powder, Tulsi leaves powder, Palash flowers powder and orange peels powder, along with suitable herbal based excipients. Pre-formulation studies were carried out to evaluate the flow and compressibility characteristics of the powder blend. Parameters such as angle of repose, bulk density, tapped density, carr's/compressibility index, hausner's ratio and loss on drying (LOD) confirmed satisfactory flow behavior and suitability of powder blend for direct compression. The formulated tablets were evaluated for various physicochemical parameters including physical appearance, pH determination, weight variation, hardness, thickness, friability, in-vitro disintegration time, invitro dispersion time, foamability, spreadability, washability, skin irritation test and stability studies. The optimized formulation (F3) exhibited excellent flow properties, acceptable mechanical strength, low friability, rapid disintegration and dispersion, satisfactory foaming ability and a skin-compatible pH. Furthermore, the tablets were found to be non-irritant, easily washable and stable under the prescribed storage conditions. The developed formulation demonstrated effective cleansing action and desirable cosmetic characteristics suitable

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routine skin care applications. The findings of the study suggest that polyherbal face wash tablets can serve as an effective, convenient and environmentally sustainable alternative to traditional liquid face wash products. The formulation offers several advantages, including improved portability, ease of handling, reduced dependence on synthetic preservatives, minimized packaging waste and enhanced consumer acceptability. Therefore, polyherbal face wash tablets represent a promising advancement in herbal cosmeceutical formulations with potential applications in the personal care and cosmetic industries.

## INTRODUCTION

The word “cosmeceutical” describes products with bioactive substances meant to improve skin health, bridging the gap between medications and cosmetics<sup>1</sup>. Due to growing consumer knowledge of the possible long-term dermatological problems connected with synthetic chemicals, the worldwide cosmetics industry has seen a substantial transition towards “Green Cosmetics” in recent years<sup>2</sup>. The main purpose of face wash formulations is to remove makeup, dead skin cells, excess sebum and environmental contaminants from the stratum corneum of the face without totally removing the skin’s natural moisture barrier<sup>3</sup>. Conventional synthetic surfactants, especially sodium lauryl sulphate (SLS), are known to disturb the skin’s natural acid layer and result in transepidermal water loss (TEWL), which causes persistent dryness, irritation and redness<sup>4</sup>. Because of their wide pharmacological spectrum and excellent safety profile, polyherbal compositions that make usage of the synergistic effects of numerous plant extracts are being given priority<sup>5, 6</sup>.

Conventional face wash formulas are mostly liquid or semi-solid solutions that include up to 90% water<sup>7</sup>. To stop microbiological growth, strong artificial preservatives such parabens must be added due to the high-water content<sup>8</sup>. An important development in sustainable pharmacy is anhydrous (waterless) technology. These formulations naturally inhibit microbial

development and lessen the need for preservatives by eliminating aqueous phase<sup>7, 9</sup>. Additionally, eliminating water weight greatly lowers the carbon footprint related to international logistics and transportation<sup>10</sup>. Because they are water-activated and travel-friendly, dry powder face washes provide a first step toward waterless cosmetics, but they are still prone to spills, moisture absorption during storage and incorrect consumer dispensing<sup>7</sup>.

The unit-dose compressed tablet technique is a crucial technological advancement to get around these restrictions<sup>11</sup>. By ensuring that the customer uses a precise, preset amount of the formulation for a single application, unit dosage administration via tablets prevents product waste<sup>12</sup>. Tablets enable extremely sustainable, eco-friendly, biodegradable packaging options, in contrast to liquid washes packaged in plastic collapsable tubes<sup>13</sup>. Tablets are also highly portable and ideal for travel, as they are spill-proof and exempt from international airport liquid volume restrictions<sup>14</sup>.

In the end, these anhydrous polyherbal tablets reduce the possibility of redness and skin irritation brought on by harsh synthetic cleansers<sup>15</sup>. In order to provide a stable, environmentally responsible and skin-friendly cleaning option, the current work focuses on the formulation, optimisation, and characterisation of an anhydrous polyherbal face wash tablet.

## MATERIALS AND METHODS:

### Materials:

#### Gathering of plant materials

Neem (*Azadirachta indica*) leaves, Tulsi (*Ocimum tenuiflorum*) leaves, Palash (*Butea monosperma*) flowers and Orange (*Citrus sinensis*) peels were among the necessary herbal ingredients that were gathered from nearby plants, marketplaces and botanical gardens.



## Herbal powders preparation

The gathered plant materials were thoroughly cleansed to get rid of contaminants and dirt<sup>16</sup>. Following that, the materials were shade-dried for a few days so as to preserve the active ingredients<sup>17</sup>. Following full drying, the materials were ground into a coarse powder using a mechanical grinder<sup>18</sup>. To create a fine powder, each powder was separately sieved through sieve number 80 and kept in airtight containers for later use<sup>19</sup>.

## Gathering of excipients

Reetha (*Sapindus mukorossi*) powder, Acacia (*Acacia senegal*) gum, Corn (*Zea mays*) starch, Potato (*Solanum tuberosum*) starch, Rice (*Oryza sativa*) powder, Sandalwood (*Santalum album*) powder and Menthol (*Mentha arvensis*) powder were all obtained from reliable sources. After being individually sieved via sieve number 80, each powder was kept in airtight containers<sup>19</sup>.

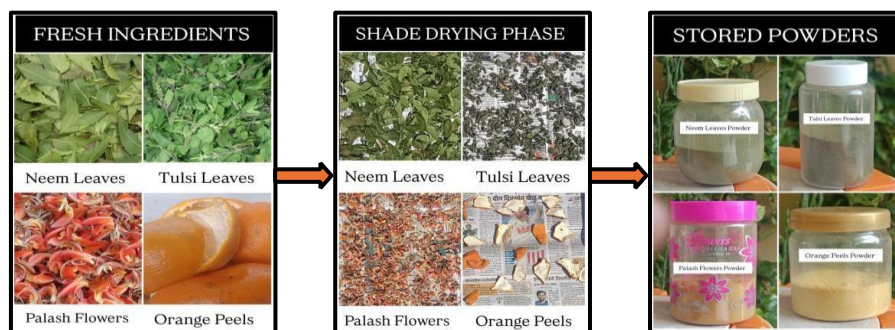


Figure 1. Process flow of preparing herbal powders from fresh ingredients via shade drying

## Methods:

### Formulation of anhydrous polyherbal face wash tablets (direct compression method)

1. Firstly, the required quantity of neem leaves, tulsi leaves, palash flowers and orange peels powders were taken and triturated in a mortar in order to get a homogeneous mixture<sup>18, 20</sup>.
2. To this mixture, reetha powder and rice powder were added and mixed thoroughly to enhance cleansing and exfoliating properties<sup>21, 22</sup>.
3. Further, corn starch was added as a diluent and disintegrant to the above mixture<sup>23</sup>.
4. Acacia gum was incorporated as a natural binder and mixed uniformly<sup>24</sup>.
5. Sandalwood powder was added to provide fragrance and skin toning effect<sup>25</sup>.
6. Potato starch was added as a lubricant to improve flow properties<sup>26</sup>.
7. Menthol powder was added at the final stage to impart a cooling sensation<sup>27</sup>.
8. The entire mixture was blended thoroughly to get a homogeneous powder blend<sup>20</sup>.
9. The prepared mixture was run through a sieve no. 60 to ensure uniform mixing and flow<sup>19</sup>.
10. The final powder blend was compressed into tablets using a tablet compression machine (direct compression method was employed)<sup>28</sup>.
11. The compressed tablets were dedusted to remove excess powder<sup>28</sup>.
12. The prepared tablets were collected and stored in an air-tight container for further use<sup>29</sup>.

**Table 1. Composition of anhydrous polyherbal face wash tablet formulation**

| Sr.no. | Herbal ingredients    | Role                                     | Batch F1      | Batch F2      | Batch F3      |
|--------|-----------------------|------------------------------------------|---------------|---------------|---------------|
| 1.     | Neem leaves powder    | Antibacterial activity                   | 25 mg         | 25 mg         | 25 mg         |
| 2.     | Tulsi leaves powder   | Antimicrobial/Anti-inflammatory activity | 20 mg         | 20 mg         | 20 mg         |
| 3.     | Palash flowers powder | Antioxidant activity                     | 15 mg         | 15 mg         | 15 mg         |
| 4.     | Orange peels powder   | Cleansing/Skin brightening activity      | 15 mg         | 15 mg         | 15 mg         |
| 5.     | Reetha powder         | Natural Surfactant/Foaming agent         | 30 mg         | 35 mg         | 40 mg         |
| 6.     | Acacia gum            | Natural Binder                           | 25 mg         | 22 mg         | 20 mg         |
| 7.     | Corn starch           | Diluent/Disintegrant                     | 40 mg         | 50 mg         | 55 mg         |
| 8.     | Potato starch         | Lubricant                                | 35 mg         | 30 mg         | 20 mg         |
| 9.     | Rice powder           | Exfoliating agent                        | 25 mg         | 22 mg         | 25 mg         |
| 10.    | Sandalwood powder     | Fragrance/Skin toning agent              | 10 mg         | 10 mg         | 10 mg         |
| 11.    | Menthol powder        | Cooling agent                            | 10 mg         | 6 mg          | 5 mg          |
|        | <b>Total</b>          |                                          | <b>250 mg</b> | <b>250 mg</b> | <b>250 mg</b> |

**Characterization of polyherbal formulations:****Pre-compression characterization of powder blend****a) Angle of repose**

The maximum angle formed between the surface of a pile of powder and the horizontal plane is known as the angle of repose. It is employed to assess the powder blend's flow characteristics. By allowing the powder to pass through a funnel that

is fixed at a specific height to create a conical heap, the Funnel technique determines the angle of repose. The angle of repose can be calculated using the formula below after measuring the heap's height (h) and radius (r):

$$\theta = \tan^{-1} (h/r)$$

where,  $\theta$  = Angle of repose; h = Height of powder cone; r = Radius of powder cone. Better flow characteristics are indicated by a lower angle of repose<sup>9, 20</sup>.

**Table 2. Powder flow characteristics according to angle of repose**

| Angle of repose (°) | Flow property |
|---------------------|---------------|
| < 25                | Excellent     |
| 25-30               | Good          |
| 30-40               | Passable      |
| > 40                | Very poor     |

**b) Bulk density**

The ratio of the weight of powder to its bulk volume prior to tapping is known as bulk density. It is crucial for figuring out tablet compression characteristics and gives information about the packing qualities of powder particles.

After precisely weighing the powder mixture, it is poured into a graduated cylinder. The powder's initial volume is recorded. To calculate the bulk density, use the following formula:

$$\text{Bulk density} = \text{Weight of powder} / \text{Bulk volume}$$

Depending on the type of powder, bulk density values can vary, although they typically fall between 0.3– 0.8 g/cm<sup>3</sup> or g/ml<sup>9, 20</sup>.



**c) Tapped density**

The proportion of weight of powder to the volume occupied upon tapping is referred to as tapped density. It offers details on compressibility and powder packing.

A graduated cylinder is filled with a specified amount of powder, then it is manually tapped 50 times. The following formula is used to determine the tapped density:

$$\text{Tapped density} = \text{Weight of powder} / \text{Tapped volume}$$

Because tapping causes powder particles to settle closer together, tapped density is always higher than bulk density<sup>9,20</sup>.

**d) Carr's index (Compressibility index)**

Powder blends compressibility and flowability are assessed using carr's index. The bulk density and tapped density numbers are employed to compute it. The formula that follows is utilised to determine the carr's index:

$$\text{Carr's Index} = (\text{Tapped density} - \text{Bulk density}) / \text{Tapped density} \times 100$$

Lower values indicate better compressibility and flow characteristics<sup>20</sup>.

**Table 3. Carr's index and associated powder blend flow characteristics**

| Carr's index (%) | Flow property | Compressibility           |
|------------------|---------------|---------------------------|
| 5-15             | Good          | Good compressibility      |
| 16-20            | Fair          | Fair compressibility      |
| 21-25            | Passable      | Poor compressibility      |
| > 25             | Poor          | Very poor compressibility |

**e) Hausner's ratio**

$$\text{Hausner Ratio} = \text{Tapped density} / \text{Bulk density}$$

Powder flow characteristics are determined using hausner's ratio. The ratio of tapped density to bulk density is used to calculate it<sup>20</sup>.

**Table 4. Hausner's ratio and associated powder blend flow characteristics**

| Hausner's ratio | Flow property | Flowability           |
|-----------------|---------------|-----------------------|
| 1.00 – 1.11     | Excellent     | Excellent flowability |
| 1.12 – 1.18     | Good          | Good flowability      |
| 1.19 – 1.25     | Fair          | Moderate flowability  |
| > 1.25          | Poor          | Poor flowability      |

**f) Loss on drying (LOD)**

An essential evaluation metric for figuring out how much moisture and volatile matter present in the powder blend is LOD. Because too much moisture can impact the stability, flow characteristics, compressibility, and hardness of tablets, it is especially crucial for anhydrous

formulations. Additionally, a high moisture level may shorten the formulation's shelf life by encouraging microbial development.

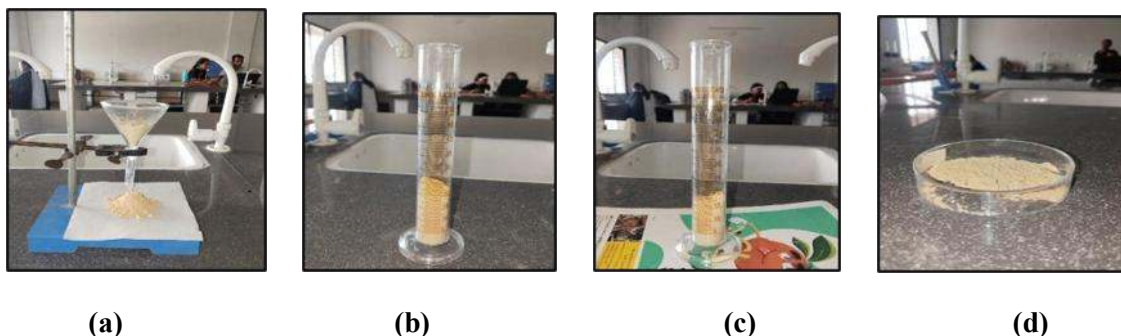
This process involves precisely weighing a predetermined amount of powder blend and drying it at 105 °C in a Hot air oven until the weight remains constant. The amount of moisture in the



sample is indicated by the weight loss during drying. The formula that follows is utilised to determine the percentage LOD:

$$\% \text{LOD} = (\text{Initial weight} - \text{Final weight}) / \text{Initial weight} \times 100$$

The LOD value should typically be kept below 5% for stable anhydrous tablet formulations so as to ensure the formulation's quality and stability<sup>9</sup>.



**Figure 2. Pre-compression characterization of powder blend: (a) Angle of repose determination (b) Bulk density measurement (c) Tapped density measurement (d) Sample preparation for loss on drying (LOD)**

## Post-compression characterization of polyherbal face wash tablets

### a) Physical appearance

The physical attributes of the created tablets, including colour, shape, surface texture and odour are assessed visually. To guarantee high quality and user acceptability, tablets should be devoid of chips, fractures and surface irregularities<sup>30</sup>.

### b) pH Determination

To make sure the formulation is suitable for the skin, pH level of the tablet solution is measured. Using a digital pH meter, one may determine the pH after the tablet is dissolved in distilled water in order to make a 1% aqueous solution. The pH value of skin care products should be between 5.5-6.5 to be able to prevent skin irritation<sup>31</sup>.

### c) Weight variation test

Tablet weight homogeneity is guaranteed using the weight variation test. An analytical balance is used to weigh each of the twenty randomly chosen tablets. After calculating the average weight, the weights of each tablet are compared to the average weight. The formula that follows is utilised to determine the percentage deviation:

$$\% \text{Deviation} = (\text{Individual weight} - \text{Average weight}) / \text{Average weight} \times 100$$

Tablets must adhere to weight variation limits based on their average weight in accordance with pharmacopeial standards (USP/IP). The permissible variance is  $\pm 5\%$  for tablets weighing 250 mg or more<sup>9</sup>.

**Table 5. USP/IP weight variation limits for tablets**

| Average tablet weight | Permissible % deviation |
|-----------------------|-------------------------|
| $\leq 80$ mg          | $\pm 10\%$              |
| 80–250 mg             | $\pm 7.5\%$             |
| $\geq 250$ mg         | $\pm 5\%$               |

**d) Hardness**

The mechanical strength of tablets and their capacity to tolerate handling during packing and transit are indicated by tablet hardness. A Monsanto, Pfizer hardness tester or other such device utilized for measure hardness. Hardness ranges from 3-6 kg/cm<sup>2</sup> for the majority of tablets to guarantee sufficient strength without compromising disintegration<sup>9</sup>.

**e) Thickness**

Tablet thickness is assessed to guarantee consistency in tablet size. It is measured in millimetres (mm) using a Micrometre screw gauge or Vernier calliper. A consistent thickness guarantees that tablets are packaged and look good<sup>9</sup>.

**f) Friability test**

The resistance of tablets to abrasion during handling and transit is assessed using friability. Roche friabilator are utilised for conduct the test. Weighing and rotating a sample of tablets at 25 rpm for 4 min. (100 revolutions). The following formula is applied in order to determine the percentage friability:

$$\% \text{Friability} = \frac{(\text{Initial weight} - \text{Final weight})}{\text{Initial weight}} \times 100$$

Less than 1% weight loss is the permissible limit for friability<sup>9</sup>.

**g) In-vitro disintegration time**

The disintegration test measures how long it takes for tablets to disintegrate into smaller particles in an aqueous medium. A USP disintegration apparatus with distilled water kept at 37°C is used to conduct the test. The quick disintegration of cleansing tablets, like face wash tablets, within 20 to 60 seconds is deemed beneficial<sup>20, 30</sup>.

**h) In-vitro dispersion time**

The time needed for the tablet to fully disperse in water was assessed using the dispersion time. The trial was carried out in a petri plate using 6ml of distilled water. The time it took for the tablet to fully disperse into tiny particles were recorded in seconds after it was carefully positioned in the center of the petri dish<sup>31</sup>.

**i) Foamability**

Foam ability is a crucial factor in face wash compositions, Because foam aids in the cleansing process. The cylinder shake method determines the foaming ability. 10ml of water are utilised for dissolve one tablet and the blend is then agitated in a measuring cylinder. Foaming ability is ascertained by calculating the height of foam generated. Better cleaning results are indicated by higher foam heights<sup>30, 32</sup>.

**j) Spreadability**

The ease whereby the formulation spreads across the skin's surface is often known as spreadability. A specific weight is applied while a tiny quantity of the formulation is placed between two glass plates. The time needed for the formulation to spread is noted and spreadability is determined using the following formula:

$$S = m \times l / t$$

Where: S = Spreadability; m = Weight applied on the upper slide; l = Length of glass slide; t = Time taken for spreading

Good spreadability guarantees that the product is applied uniformly to the skin<sup>32</sup>.

**k) Washability**

The ease with which a product can be washed from the skin with water is determined by its washability. After applying the mixture to the skin, water is used to rinse it off. A decent face wash



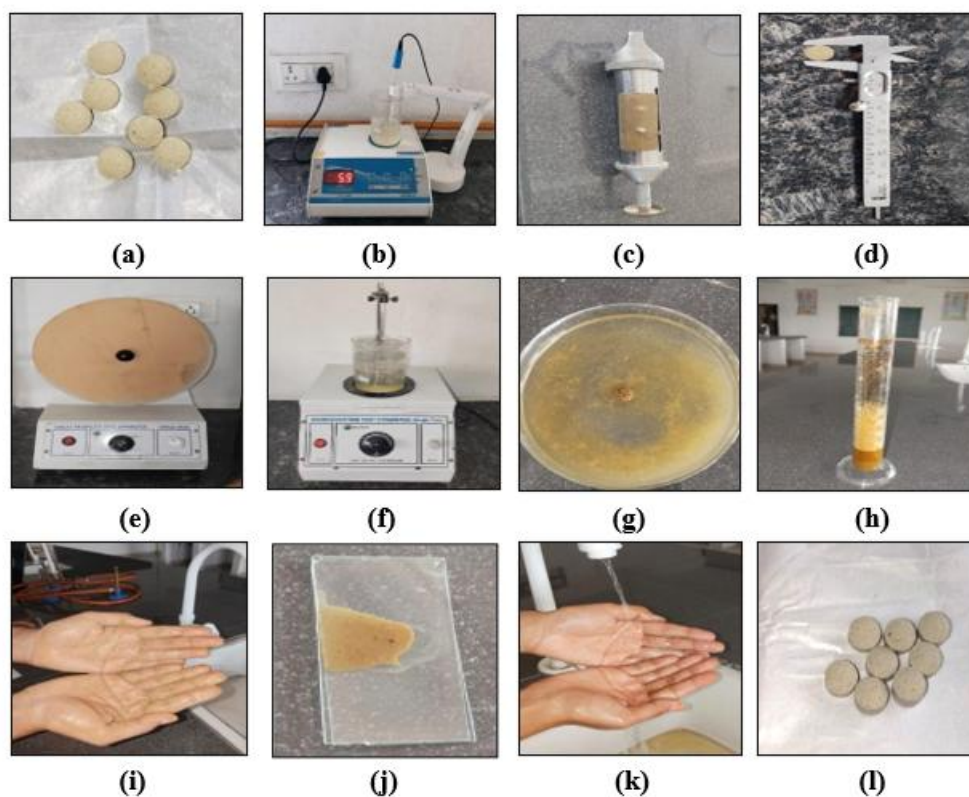
tablet should be easy to remove and leave no residue<sup>30</sup>.

### l) Skin irritation test

The formulation's safety is assessed by a skin irritation test. After applying a tiny bit of the tablet solution to the skin, it is checked for redness, irritation, swelling or itching after 1-2 hours. There should be no indications of irritation in a safe formulation<sup>30, 32</sup>.

### m) Stability studies

Studies of stability are carried out to determine the physical and chemical stability and shelf-life of the prepared tablets under different storage conditions. For a predetermined amount of time (often one to three months), the tablets are kept in sealed containers at room temperature and accelerated conditions ( $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and  $75\% \pm 5\% \text{ RH}$ ). Physical appearance, pH, hardness and disintegration time are among the criteria that are regularly assessed during the study period. If a formulation's performance and physical characteristics do not significantly change, it is deemed stable<sup>33</sup>.



**Figure 3. Post-compression characterization of polyherbal face wash tablets: (a) Physical appearance of formulated tablets (b) pH determination of formulation using calibrated digital pH meter (c) Determination of mechanical breaking force using Monsanto tablet hardness tester (d) Dimensional thickness measurement using Vernier caliper (e) Evaluation of mechanical integrity and percentage friability using Roche friabilator (f) In-vitro disintegration time test progress monitoring the structural breakdown of the tablets (g) In-vitro dispersion time and visual behaviour characterization of the tablet in an aqueous medium (h) Evaluation of foam volume via graduated cylinder method (i) Visual assessment of lather consistency and foam texture on hands (j) Determination of spreadability characteristics using glass slide apparatus (k) Washability and residue clearance assessment under running water (l) Stability evaluation of formulated tablets post 1-3 months storage interval**

**RESULTS AND DISCUSSION:****Table 6. Pre-compression characterization of powder blend**

| Sr.no. | Evaluation parameters                | Batch F1  | Batch F2  | Batch F3  |
|--------|--------------------------------------|-----------|-----------|-----------|
| a)     | Angle of repose ( $\theta$ )         | 35.2 °    | 31.4 °    | 24.8 °    |
| b)     | Bulk density                         | 0.41 g/ml | 0.44 g/ml | 0.48 g/ml |
| c)     | Tapped density                       | 0.53 g/ml | 0.54 g/ml | 0.55 g/ml |
| d)     | Carr's index (Compressibility index) | 22.6 %    | 18.5 %    | 12.7 %    |
| e)     | Hausner's ratio                      | 1.29      | 1.22      | 1.14      |
| f)     | Loss on drying (LOD)                 | 4.6 %     | 4.1 %     | 3.5 %     |

**Table 7. Post-compression characterization of polyherbal face wash tablets**

| Sr.no. | Evaluation parameters          | Batch F1                     | Batch F2                   | Batch F3                                        |
|--------|--------------------------------|------------------------------|----------------------------|-------------------------------------------------|
| a)     | Physical appearance            |                              |                            |                                                 |
|        | Colour                         | Light brown                  | Greenish-brown             | Light beige to pale brown                       |
|        | Shape                          | Irregular with edge chipping | Circular with uneven edges | Circular, flat faces and slightly rounded edges |
|        | Surface                        | Rough and non-uniform        | Smooth, slightly pitted    | Slightly rough and porous                       |
|        | Appearance                     | Matte, uncoated              | Matte, uncoated            | Matte, uncoated                                 |
|        | Odour                          | Mild characteristic          | Mild characteristic        | Mild characteristic                             |
| b)     | pH Determination (1% Solution) | 5.2                          | 5.5                        | 5.9                                             |
| c)     | Weight variation test          | 250 ± 8 mg                   | 250 ± 5 mg                 | 250 ± 2 mg                                      |
| d)     | Hardness                       | 2.8 kg/cm <sup>2</sup>       | 5.2 kg/cm <sup>2</sup>     | 4.1 kg/cm <sup>2</sup>                          |
| e)     | Thickness                      | 4.2 mm                       | 4.1 mm                     | 4.0 mm                                          |
| f)     | Friability test                | 1.25%                        | 0.45%                      | 0.72%                                           |
| g)     | In-vitro disintegration time   | 110 sec                      | 55 sec                     | 24 sec                                          |
| h)     | In-vitro dispersion time       | 145 sec                      | 82 sec                     | 48 sec                                          |
| i)     | Foamability                    | 4 cm                         | 6 cm                       | 9 cm                                            |
| j)     | Spreadability                  | 5.2 g·cm/s                   | 6.1 g·cm/s                 | 7.8 g·cm/s                                      |
| k)     | Washability                    | Good                         | Good                       | Excellent                                       |
| l)     | Skin irritation test           | No irritation                | No irritation              | No irritation                                   |
| m)     | Stability studies (1-3 months) | Not evaluated                | Not evaluated              | Stable                                          |

The present study effectively demonstrated that the direct compression method can be successfully employed to formulate an anhydrous polyherbal face wash tablet. In order to achieve the intended physicochemical properties and functional performance of the proposed formulation, the choice of herbal ingredients and appropriate excipients was crucial. The results presented in table 6 and table 7 indicate that the formulation

strategy was successful in creating tablets with acceptable quality characteristics appropriate for use in face washing.

The pre-compression characterization results (table 6) confirmed that the powder blends possessed satisfactory compressibility and flowability properties for direct compression. Adequate flow characteristics are essential for reliable tablet manufacture and homogeneous die



filling. The balanced excipient composition, which improved particle arrangement and decreased interparticle friction, may be responsible for the improved flow behaviour shown in the optimised batch F3. Studies using herbal tablet formulations made by direct compression have revealed similar findings<sup>15, 24</sup>.

The produced tablets had adequate mechanical strength and physical features, according to post-compression examination (figure 3 and table 7). Maintaining tablet integrity throughout handling, packing and transportation requires the right amount of hardness and minimal friability. The ideal balance between mechanical strength and quick disintegration was demonstrated by the optimised batch F3, suggesting that it's suitable for practical application. Similar outcomes have been reported in earlier studies where tablet performance was greatly enhanced by optimising binder and disintegrant concentrations<sup>18, 24</sup>.

The pH of tablets was found to be within the skin-compatible range (table 7), indicating that they might be utilised in regular face washing. Maintaining the proper pH is crucial for protecting the skin's natural barrier and reducing inflammation. The dermatological safety of the chosen herbal components is further supported by the lack of irritation during skin compatibility examinations (table 7). The antibacterial, antimicrobial, anti-inflammatory, antioxidant, cleaning and skin-brightening qualities of herbal ingredients including neem, tulsi, palash and orange peel have been well documented. These qualities may enhance the formulation's overall efficacy<sup>3, 19</sup>.

Because they have a direct impact on consumer acceptance and convenience, rapid disintegration and dispersion are crucial features of face wash tablets. Effective water penetration and swelling action inside the tablet matrix may be responsible for the effective tablet breakdown observed in optimised batch F3 (table 7). Rapid tablet

disintegration facilitates quick preparation of the cleansing formulation and enhances user convenience. Tablet formulations with effective disintegrating agents have been shown to exhibit similar behaviour<sup>3, 24</sup>.

Foaming ability, spreadability and washability are important characteristics of cleaning products. The optimized formulation demonstrated superior foamability, spreadability and excellent washability (table 7). Sufficient foam production helps clear the skin's surface of pollutants, excess oil and debris. Additionally, superior spreadability and washability guarantee efficient cleaning without leaving unwanted residue on the skin and improve user ease<sup>15</sup>.

The stability study indicated that batch F3 did not considerably alter in appearance or performance characteristics during the storage term (figure 3 and table 7). Because the formulation is anhydrous, there is less chance of microbial contamination and moisture-related deterioration, which may have increased stability. Compared to traditional aqueous formulations, which frequently need greater preservative concentrations to maintain product stability, this is a significant advantage<sup>1, 2</sup>.

Overall, the findings of the present study indicate that polyherbal face wash tablets are a viable substitute for traditional liquid face cleansers. The developed formulation offers a convenient, portable, eco-friendly and skin-friendly washing method by combining the benefits of herbal ingredients, anhydrous technology and tablet dosage form. The study emphasises the potential of polyherbal face wash tablets as a cutting-edge strategy for sustainable skincare products and herbal cosmeceuticals.

## CONCLUSION

The current work effectively created an anhydrous polyherbal face wash tablet using the direct compression method. Pre-compression



characterisation showed appropriate flow and compressibility characteristics of the powder blends while post-compression investigations verified acceptable physicochemical features of the produced tablets. Excellent flowability, good compressibility, acceptable mechanical strength, rapid disintegration and dispersion, superior foamability, enhanced spreadability, skin-compatible pH, excellent washability and lack of skin irritation were among the most desirable features of batch F3 among the formulations examined. During the storage period, the optimised formulation also held steady.

The study's outcomes show that polyherbal face wash tablets are a viable substitute for traditional liquid face cleansers. Benefits of the anhydrous unit-dose method include increased stability, decreased need for preservatives, better portability and environmental sustainability. Consequently, the produced composition offers a huge deal of potential for use as an environmentally friendly herbal skincare product. To promote future commercial development, more research involving microbiological characterisation, long-term stability studies and user acceptance evaluations is advised.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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