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Research Article

Formulation and Evaluation of Herbal Immunity Powder for Pediatrics

Aditya Khode*, Nandkishor Deshmukh, Dr. Swati Deshmukh

Shraddha Institute of Pharmacy, Washim, Maharashtra, 444505

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ABSTRACT

This study is about making and testing a herbal immunity powder that's safe for children to use. Kids who have weak immunity often have a lack of certain nutrients, which can cause them to get sick often and not feel well. The powder uses natural ingredients like amla, giloy, tulsi, and pomegranate, along with important nutrients such as vitamin D3 and zinc to help boost the immune system. The powder was made using standard techniques like drying, grinding, sieving, and mixing with other substances to make it more stable and easier to take. They checked several things to evaluate the powder, including how well it dissolves in water and milk, how tightly it packs, how it flows, its moisture level, and its pH. The results showed that the powder dissolves well, flows smoothly, has low moisture, and a pH that's almost neutral. Overall, the product is stable, safe, and works well as a natural way to help children's immunity.

INTRODUCTION

Pediatric immunodeficiency has become a significant health issue because of widespread dietary and micronutrient deficiencies in children. Lack of essential nutrients like vitamins A and D, iron, zinc, and proteins can harm the development and function of the immune system, affecting both the innate and adaptive immune responses. This makes children more prone to repeated respiratory and gastrointestinal infections, slows down recovery, and leads to poor general health. Poor eating habits, limited variety in the diet, frequent illnesses, and socioeconomic factors can further weaken a child's immunity. Immune deficiency in early life may also affect growth, cognitive development, and how well vaccines work (1). In Ayurveda, immunity is known as Ojas, which represents the body's ability to defend against disease. The immune system fights pathogens such as bacteria, viruses, fungi, and parasites through innate and adaptive mechanisms. Herbal medicines containing bioactive compounds with antioxidant, anti-inflammatory, and antimicrobial

***Corresponding Author:** Aditya Khode
Address: *Shraddha Institute of Pharmacy, Washim, Maharashtra, 444505*
Email : adityakhode7083@gmail.com

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properties have shown promise in boosting immunity (2,3,4).

Immunity

Immunity is the body's way of protecting itself against harmful microorganisms like bacteria, viruses, fungi, and parasites. (2) There are two main types of immunity: innate and acquired (also known as adaptive). Innate immunity is something a person is born with, works quickly, and provides general protection through things like skin, mucus, white blood cells, and inflammation. Acquired immunity develops after the body is exposed to specific harmful substances called antigens. It takes longer to respond but offers precise protection and has a memory so the body can fight off the same pathogen again more effectively. (5) In young children, the immune system is not yet fully developed. Their T-cells and B-cells, which are important for fighting infections, are less active. They also make fewer antibodies and don't form strong immune memories as easily. This makes them more prone to getting sick and less responsive to vaccines. Herbal immunomodulators can help improve immune function by boosting both innate and acquired immunity. (3,4)

Herbal Immunity Powder

Herbal immunity formulations work by combining various bioactive plant components that have immunomodulatory, anti-inflammatory, antioxidant, and antimicrobial properties. When multiple herbs are used together in a polyherbal mixture, they provide a more effective immune boost compared to using a single herb. Essential nutrients like zinc and vitamins A, C, D, and E also play a key role in supporting and strengthening the immune system (6). Pomegranate is recognized for its antiviral, antioxidant, and anti-inflammatory properties, which help reduce oxidative stress, regulate cytokines, and improve the function of immune cells (7). Amla, also known as Emblica officinalis, is high in vitamin C and minerals, and it has strong antioxidant and immunomodulatory effects that help increase resistance to diseases (8). Giloy, or Tinospora cordifolia, supports immunity by activating macrophages, increasing antioxidant activity, and regulating inflammation, making it beneficial for people who suffer from frequent infections (9,10). Tulsi, or Ocimum sanctum, supports both the body's innate and adaptive immune responses by reducing oxidative stress and enhancing immune function (11). Vitamin D3 is especially important for children's immunity, as it helps regulate immune cells, reduce inflammation, and prevent infections (12).

Fig.1 Herbal Powders Used in Powder Formulation

MATERIAL AND METHOD

A. Materials:

Herbal Ingredients

1. **Pomegranate –** Anar, Dalim.

Pomegranate is the fruit from *Punica granatum*, which is belong to family *Lythraceae*. It is a type of shrub that loses its leaves seasonally. It contains chemicals like Punicalagin, Punicalin, Gallic acid, Ellagic acid, Ellagitannins, and other polyphenolic compounds. It acts as a powerful antioxidant, anti-inflammatory, and immune regulator. It also helps protect the heart and manage diabetes. It has potential to fight cancer, supports gut and skin

health, and is commonly used in health supplements and special foods as a natural healing ingredient (13).

Fig.2 Pomegranate

2. **Amla –** Amla, Amalaki, Indian Gooseberry.

Amla, is a fruit derived from the tree *Phyllanthus emblica*, which belongs to the *Phyllanthaceae* family. The fruit contains various chemical components such as ascorbic acid (vitamin C), gallic acid, ellagic acid, emblicanin A, emblicanin B, tannins, flavonoids, and polyphenols. It is used as an antioxidant, anti-inflammatory, and immunomodulatory agent. It also offers cardioprotective and antidiabetic benefits, supports digestion and gut health, exhibits hepatoprotective and anticancer properties, and is commonly found in nutraceuticals and functional foods (14).

Fig.3 Amla

3. **Giloy –** Guruchi (Sanskrit), Amrita (Sanskrit), Gulvel (Marathi), Tinospora.

Giloy is derived from *Tinospora cordifolia*, which belongs to the *Menispermaceae* family and is a climbing shrub. Its chemical components include alkaloids such as berberine and magnoflorine, glycosides, and steroids. It is used as an immunomodulatory, anti-inflammatory, and antidiabetic agent. It also supports digestion and liver health and is beneficial in treating chronic fever and inflammatory conditions (15).

Fig.4 Giloy

4. **Tulsi** – Tulsi, Holy Basil.

Tulsi comes from the plant *Ocimum sanctum*, also known as *Ocimum tenuiflorum*, which is part of the *Lamiaceae* family. It is a fragrant and medicinal plant. The plant contains various chemical compounds such as eugenol, ursolic acid, rosmarinic acid, and flavonoids. It is used as an antioxidant, anti-inflammatory, immune-supporting, and antimicrobial remedy. It helps improve immunity, support respiratory health, and ease stress (16).

Fig.5 Tulsi

Excipients

The excipients used in the formulation of Herbal Immunity Powder for Pediatrics are as follows: (17, 18, 19, 20, 21, 22)

- Vitamin D3 *(Cholecalciferol).*
- Zinc.
- Magnesium stearate.
- Cocoa powder.
- Saccharin.
- MCC *(Microcrystalline Cellulose)*

B. Method:

Collection of material

Amla, Giloy, pomegranate, and Tulsi were bought from the market, dried, and then ground into powder. Vitamin D3, zinc bisglycinate, and other inactive ingredients were sourced from Shraddha Institute of Pharmacy. Cocoa powder was purchased locally. All the materials used were of analytical grade.

Method of preparation

1. Washing

Rinse raw material under running water to remove dirt or impurities.

2. Drying

All herbal drugs were shade dried for several days to remove moisture and preserve active constituents.

3. Powdering

The dried materials were finely powdered using a mechanical grinder or mortar & pestle.

4. Sieving

The powders were passed through a sieve (40–80 mesh) to obtain uniform particle size. (23)

5. Mixing of all ingredients

Step 1: Weighing of ingredients

Accurately weigh all ingredients according to the formulation.

Step 2: Mixing of herbal powders

Amla, Giloy, Pomegranate, and Tulsi powders were mixed thoroughly to obtain a uniform blend.

Step 3: Addition of active ingredients

Vitamin D_3 and zinc were added to the powder mixture and mixed uniformly.

Step 4: Addition of excipients

Microcrystalline cellulose (MCC) and magnesium stearate were added to improve flow and compressibility.

Step 5: Addition of sweetening and flavoring agents

Saccharin and cocoa powder were added to enhance taste and palatability.

Step 6: Mixing

The final mixture was mixed thoroughly using **a** mortar & pestle or by geometric dilution method to ensure uniform distribution of all ingredients.

6. Packaging

The prepared powder was transferred into clean, dry, airtight containers.

7. Storage

The formulation was stored in a cool, dry place away from moisture and direct sunlight (24)

Formulation table

Table No.1: Formulation Table of Herbal Immunity Powder

Sr. No.	Ingredient	F1(g)	F2(g)	F3(g)	Uses
1	Amla *(Phyllanthus emblica)*	5.0	5.5	6.0	Immunity booster, antioxidant.
2	Tinospora Giloy *(Tinospora cordifolia)*	4.0	4.0	3.5	Enhances immunity
3	Pomegranate seeds *(Punica granatum)*	3.0	2.5	2.5	Antioxidant, supports immune and cardiovascular health
4	Tulsi *(Ocimum sanctum)*	2.0	2.0	2.0	Antimicrobial, supports respiratory health and immunity
5	Vitamin D3 *(Cholecalciferol)*	0.01	0.01	0.01	Enhances calcium absorption, supports bone health, boosts immune response
6	Zinc	1.0	1.0	1.0	Supports immune function, wound healing, enzyme activity, and growth
7	Magnesium stearate	0.25	0.25	0.25	Lubricant; improves powder flow and prevents sticking during processing
8	Cocoa powder	3.0	3.5	4.0	Flavoring agent; improves palatability, provides antioxidants
9	Saccharin	0.25	0.30	0.35	Sweetening agent; improves taste and patient compliance
10	MCC *(Microcrystalline Cellulose)*	6.49	5.94	5.39	Diluent and binder; improves bulk, flow properties, and stability
Total		25g	25g	25g	

Fig.7 Prepared Herbal Immunitty Powder

EVALUATION PARAMETERS

To make sure the herbal pediatric immunity powder is safe, effective, and of good quality, certain parameters were checked. These tests help determine the product's physical properties and whether it is suitable for use in children.

A. Solubility

1 gram of powder was tested in water, milk, ethanol, acetone, hydrochloric acid, and chloroform.

The solubility was noted as soluble, sparingly soluble, or not soluble. Good solubility in water and milk suggests it is suitable for use in children's medicine. (25)

B. Appearance

The appearance was checked by looking at and smell through visual and sensory methods. This helps to make sure the product is acceptable and tasty for children. (26)

C. Particle Size

The particle size was checked using a 40–80 mesh sieve. Only small particles were left behind, which ensures a smooth texture and better taste. (27)

D. Flow Properties

1. Angle of Repose

These measures how well the powder flows. It is calculated using the formula:

$$\textbf{Angel of repose } \theta = \tan^{-1}\left(\frac{h}{r}\right)$$

2. Bulk Density

A known mass of powder was poured into a graduated cylinder without tapping.

Bulk density was calculated using the formula:

$$\textbf{Bulk Density} = \left(\frac{\textbf{mass of powder (g)}}{\textbf{bulk volume (ml)}}\right)$$

3. Tapped Density

Measures mass per unit volume after mechanical tapping.

Tapped density was calculated using the formula:

$$\textbf{Tapped Density} = \left(\frac{\textbf{Mass of Powder}}{\textbf{Tapped volume}}\right)$$

4. Carr's Index

Carr's Index indicates powder flowability and compressibility.

Calculated using the formula:

$$\textbf{Carr's Index} = \left(\frac{\textbf{Tapped Density} - \textbf{Bulk Density}}{\textbf{Tapped Density}}\right) \times 100$$

5. Hausner's Ratio

Another indicator of flow properties.

Calculated using the formula:

$$\textbf{Hausner Ratio} = \left(\frac{\textbf{Tapped Density}}{\textbf{Bulk Density}}\right)$$

A lower ratio (< 1.25) suggests good flowability. (28)

E. Moisture Content:

Moisture content was determined using a drying method to check stability and how long the product will stay good. (29)

Moisture content was calculated as

$$\textbf{Moisture content } (\%) = \left(\frac{\textbf{Initial weight} - \textbf{Final weight}}{\textbf{Initial weight}}\right) \times 100$$

F. pH

Determines oral compatibility. 1 g powder in 10 mL water (1:10 w/v) is prepared and measured using a pH meter. The ideal pH range is 5–7, which is suitable for pediatric oral administration. (30)

RESULT AND DISCUSSION

Result

Table No. 2: Solubility

Solvent	Observation
Water	Soluble
Milk	Soluble
HCL	Sparingly soluble
Ethanol	Sparingly soluble
Acetone	Insoluble
Chloroform	Insoluble

Table No. 3: Appearance

Parameter	F1	F2	F3	Interpretation
Colour	Light brown	Light brown	Light brown	Uniform herbal appearance
Texture	Smooth, fine	Smooth, fine	Smooth, fine	Good uniformity, no grittiness
Fragrance	Chocalate aroma	Chocalate aroma	Chocalate aroma	Pleasant and acceptable

Table No. 4 Flow Properties

Parameter	F1	F2	F3	Interpretation
Angle of Repose	31.0°	31.7°	31.0°	Indicates good flow property
Bulk Density	0.714 g/mL	0.725 g/mL	0.687 g/mL	Indicates moderate packing
Tapped Density	0.889 g/mL	0.905 g/mL	0.869 g/mL	Reflects good particle rearrangement and packing upon tapping
Carr's Index	19.7	18.9	14.8	F1 & F2: fair to good flowability; F3: good flowability
Hausner's Ratio	1.24	1.23	1.17	F1 & F2: fair to good flow property; F3: good flow property

Table No. 5: Moisture Content

Parameter	F1	F2	F3	Interpretation
Moisture Content	1.76%	2.10%	3.00%	Indicates acceptable moisture; F3 slightly higher but within limit

Table No. 5: pH

Parameter	F1	F2	F3	Interpretation
pH	6.1	6.3	6.2	Suitable for pediatric use

DISCUSSION

The study found that the herbal immunity powder has the right physical and chemical properties, making it suitable for use in children. All three versions (F1 to F3) dissolved well in water and milk, which makes it easy to give to kids. The way the powder flows is good enough for handling and putting into packages. The pH level is close to neutral, which means it's safe for children to take by mouth. The low amount of moisture in the powder shows it's stable and less likely to get contaminated by microbes. Small differences between the formulas are within acceptable ranges. Adding cocoa powder and saccharin made the taste better, helping kids take the powder more willingly. Overall, the results show the product meets quality standards and is fit for use in children.

CONCLUSION

The study created and tested a herbal immunity powder for children, combining amla, giloy, tulsi, and pomegranate along with vitamin D3 and zinc to help boost the immune system. The powder was made using straightforward methods to ensure the ingredients mixed evenly and remained stable. Tests on solubility, particle size, how easily it flows, moisture levels, and pH showed that the product is of high quality and suitable for children. All the versions of the powder dissolved well in water and milk, had good flow, low moisture content for better stability, and a nearly neutral pH, which makes it safe. Adding cocoa powder and saccharin improved the taste and made it more acceptable to kids. Overall, this formulation is safe, stable, and has potential as an effective immunity booster.

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