



Formulation and evaluation of pediatric immune booster and appetite stimulant chocolate

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Abstract

This study focuses on the formulation and evaluation of a herbal-based pediatric immune booster and appetite stimulant chocolate using natural ingredients such as ashwagandha, ajwain, and cardamom incorporated into a cocoa butter and dark chocolate base. The objective was to develop a palatable, safe, and nutritionally beneficial formulation to address common issues in children such as poor appetite, malnutrition, and weakened immunity. The prepared formulations (f1, f2, and f3) were evaluated for organoleptic properties, pH, chemical tests, weight variation, and blooming test. The results showed uniform dark brown Colour, acceptable sweet taste with slight bitterness, stable pH range (5.2–5.3), and positive tests for carbohydrates and proteins. No fat bloom was observed initially, and weight variation was within acceptable limits, indicating good stability and uniformity. The study concludes that the developed herbal chocolate is a promising, child-friendly formulation that can serve as a functional dietary supplement to improve appetite and support immunity, with further studies recommended for long-term stability and clinical efficacy.

Keywords: To Cocoa Butter; Heatproof Bowl; Double Boiler; Low Heat; Gentle Heating; Melting; Stirring; Smooth Texture; Dark Chocolate; Small Pieces; Continuous Stirring; Uniform Mixture

1. Introduction

The immune system is essential for preserving general health and wellbeing. The body's defense against bacteria, viruses, fungi, and other pathogens is provided by the immune system, a sophisticated and intricate network of cells, tissues, and organs.[1] Because of their fast growth, exposure to the environment, and poor nutrition, children are particularly vulnerable to recurring illnesses, poor appetite, malnutrition, and compromised immunity.[2] Synthetic chemicals, artificial sweeteners, and preservatives are frequently used in conventional pediatric appetite stimulants and immune boosters, which may have negative effects with extended use.[3] Ashwagandha, or *Withania somnifera*, is a member of the Solanaceae family. Ashwagandha is sometimes referred to as winter cherry or Indian ginseng. Because of its multimodal effects, ashwagandha is one of the many botanicals used in Ayurvedic medicine.

Researchers have thoroughly examined the many pharmacological actions, such as immunomodulatory, anti-inflammatory, antioxidant, and anti-stress properties.[4] The innate immune system and the adaptive immune system are the two basic parts of the immune system. Instantaneous, general defense mechanisms are provided by the innate immune system. The adaptive immune system, on the other hand, is extremely specialized and has the ability to "remember" prior interactions with particular infections, enabling a more focused and effective reaction in the event of future exposures.[1] In order to maintain a strong immune system, nutrition is essential. Maintaining immunological function requires a sufficient intake of vital nutrients, such as vitamins (like C, D, and E), minerals (such zinc and iron),

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and other bioactive substances. Lack of these minerals might weaken the immune system and make a person more vulnerable to infections [5].

In both clinical and nutritional sciences, appetite stimulation in pediatric populations is a major concern. Children with poor appetites may not consume enough nutrients, grow more slowly, have weaker immune systems, and experience developmental delays. Children's decreased appetite can be caused by a number of things, including illness, mental stress, medicine, or typical dietary preferences. As a result, there is an increasing need for novel, kid-friendly formulations that assist naturally and securely increase appetite while simultaneously addressing nutritional shortages.

Trachyspermum ammi L. This highly prized and medicinally significant seed spice is a member of the Apiaceae family. Ajwain oil, a colorful oil, is found in the seeds. Thymol, the primary ingredient in this oil, is used to treat bronchial issues, gastrointestinal disorders, and appetite loss.[6] In order to promote appetite stimulation, development, and general health, the formulation is intended to work as a functional dietary supplement or snack that can be added to regular pediatric nutrition regimes. The innate drive to eat is known as appetite, and it is usually controlled by a complex interplay of environmental, psychological, and physiological factors.

It is essential for sustaining growth, preserving energy balance, and guaranteeing general health. [7-8] Children who have a persistent lack of appetite may experience undernutrition, weight loss, stunted growth, and delayed development. As a result, treating appetite-related problems is essential to pediatric nutrition and healthcare.[9]

Conventional methods for increasing children's appetite frequently include dietary changes, better mealtime routines, and occasionally the use of pharmaceutical appetite stimulants. Nevertheless, these techniques could not be very efficient or might have negative impacts. Natural and food-based remedies, like the utilization of functional foods and herbal compounds with appetite-boosting qualities, have become more popular as a result.[10] The creation of tasty, nutrient-dense food items, such as functional chocolate, has surfaced as a potential tactic to increase children's appetites in recent years. A safer and more palatable substitute for artificial hunger stimulants, these products can be enhanced with natural substances recognized for their medicinal advantages.[11]

2. Materials

2.1. Ashwagandha

- Synonym: Winter cherry and Indian ginseng
- Biological source: Ashwagandha consists of dried roots of *Withania somnifera* belonging to family Solanaceae
- Chemical constituents: Withanolides, Alkaloids (somniferine, withanine), Saponins, Steroidal lactones
- Pharmacological activity: Immunomodulatory, Adaptogenic, Anti-stress, Anti-inflammatory, improves strength and vitality[12]



Figure 1 Ashwagandha

2.2. Ajwain

- Synonym : Bishop's weed, Carom seeds

- Biological source : Ajwain consist of dried ripe fruits (seeds) of *Trachyspermum ammi* belonging to family Apiaceae.
- Chemical constituents : Thymol (major component), Essential oils, Terpenes, Flavonoids
- Pharmacological activity : Appetite stimulant, Carminative, Antimicrobial, Digestive aid, Antispasmodic.[13]



Figure 2 Ajwain

2.3. Cardamom

- Synonym : Small cardamom, Green cardamom
- Biological source : Cardamom consists of dried ripe fruits (capsules) of *Elettaria cardamomum* belonging to family Zingiberaceae.
- Chemical constituents : Volatile oils (cineole, terpinyl acetate), Flavonoids, Fixed oils
- Pharmacological activity : Digestive stimulant, Flavoring agent, Carminative, Mild antimicrobial, Improves palatability [14]



Figure 3 Cardamom

3. Method of preparation

3.1. Prepare the herbal ingredients

Ashwagandha powder is measured into a small bowl, while dried cardamom seeds are ground into a fine powder using a mortar and pestle or grinder. Both powders are passed through sieve no. 85 and combined carefully to ensure uniform distribution. For ajwain maceration, crushed seeds are placed in an airtight container with an appropriate solvent and maintained at room temperature for 24–72 hours with occasional stirring to achieve a concentrated extract.

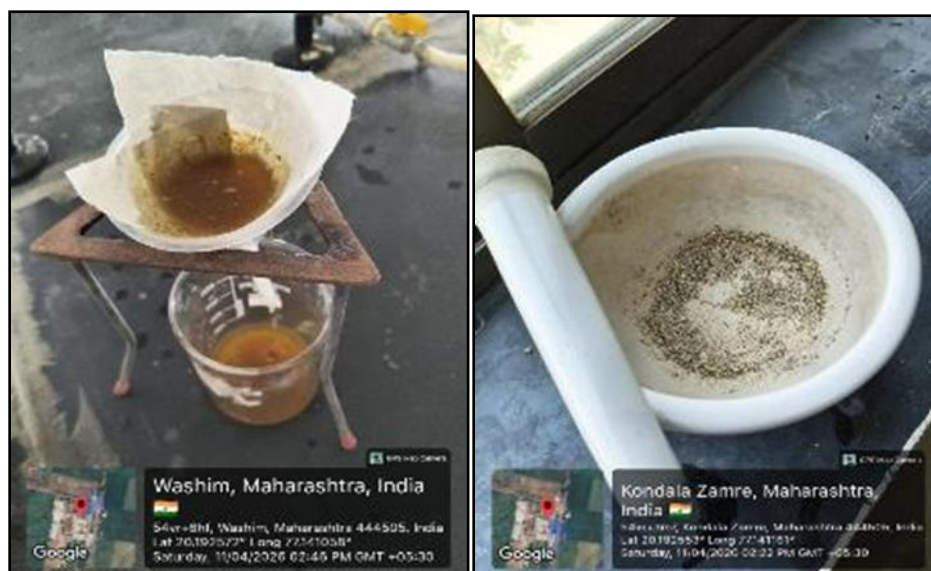


Figure 4 Filtration of extract and Traturation of Cardamom

3.2. Melt the cocoa butter & dark chocolate

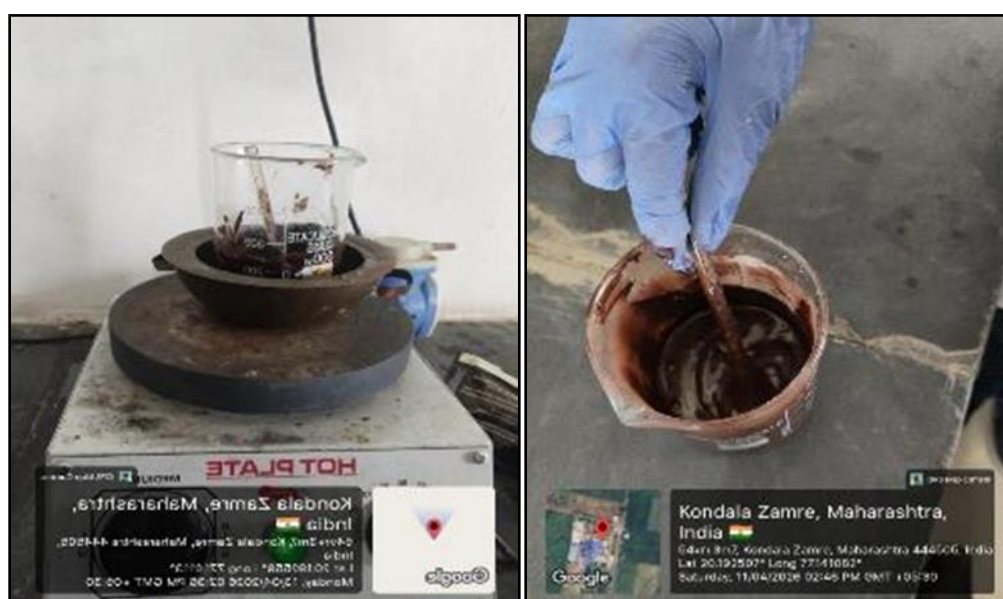


Figure 5 Formulation of chocolate

This method serves as a heatproof bowl or double boiler, and it should be gently heated over low heat, stirring occasionally to ensure the cocoa butter melts smoothly without burning. Once the cocoa butter has completely melted, add the dark chocolate broken into small pieces into the same double boiler, and continue stirring continuously until the chocolate is fully melted and the mixture becomes smooth and uniform. The cocoa butter is in sufficient quantity. However, the real issue is the cement and gravel—there's not enough of them.

3.3. Mix excipients & set the chocolates

This method functions as a means to melt and uniformly mix the chocolate. Once melted and mixed, the measured herbal powders are added to the mixture. It is then stirred thoroughly to ensure that all the powders are evenly distributed and well blended into the cocoa butter and chocolate, forming a homogeneous mixture.[2] The smooth mixture is poured into molds or a lined tray and tapped to remove air bubbles. It is then refrigerated for 2 hours until hardened. The cements and gravels are then removed or broken into pieces and stored in an airtight container in a cool, dry place or in the refrigerator.[15]

Table 1 Formulation table

Sr. No.	Ingredients	F1	F2	F3
1.	Ashwagandha	0.5 g	0.7 g	0.6 g
2.	Ajwain	0.4 ml	0.5 ml	0.6 ml
3.	Cardamom	0.4 g	0.3 g	0.4 g
4.	Powdered sugar	3.0 g	2.8 g	3.2 g
5.	Cocoa butter	4.0 g	4.2 g	3.8 g
6.	Dark chocolate	6.8 g	6.5 g	6.4 g
7.	Rosemary	0.05 ml	0.05 ml	0.05 ml

3.4. Evaluation

- Organoleptic : This method serves as an evaluation tool for chocolate formulation, assessing overall appearance, elegance, and visual appeal to ensure consumer acceptability and consistency.
- Colour: The Colour of the chocolate is examined visually.
- Taste: The taste is evaluated through tasting.
- pH measurement: The pH of the formulation is measured using a digital ph meter.
- Test for carbohydrates (Fehling's test): Equal amounts of Fehling's solution A and B are added to the sample and heated; the formation of a brick-red precipitate indicates the presence of carbohydrates.
- Test for protein (biuret test): The chocolate formulation is mixed with 4% NaOH and a few drops of 1% copper sulphate solution; a violet Colour confirms the presence of proteins.
- Weight variation: Individual and total weights of chocolates are measured, the average weight is calculated, and percentage deviation is determined by comparing individual weights with the average weight.
- Blooming test (fat bloom): A white layer forming on the chocolate's surface due to fat recrystallization is observed, which affects appearance and can be minimized by proper storage at a constant temperature.[22]

4. Result

The formulated pediatric immune booster and appetite stimulant chocolate, prepared using ashwagandha, ajwain, and cardamom with a cocoa butter and dark chocolate base, showed satisfactory results. All formulations (f1, f2, and f3) exhibited a uniform dark brown Colour and a sweet taste with slight bitterness. The pH values ranged from 5.2 to 5.3, indicating good stability. Chemical tests confirmed the presence of carbohydrates (brick-red precipitate in Fehling's test) and proteins (violet Colour in biuret test). The chocolates also showed uniform weight distribution, and no visible fat bloom was observed initially, indicating good quality and stability of the formulation.

5. Discussion

The study demonstrated that a herbal-based pediatric immune booster and appetite stimulant chocolate can be successfully formulated using ashwagandha, ajwain, and cardamom incorporated into a cocoa butter and dark chocolate base. The uniform dark brown Colour, pleasant sweet taste with slight bitterness, and absence of initial fat bloom indicate good organoleptic properties and product stability. The pH values within a narrow range suggest formulation consistency, while positive Fehling's and biuret tests confirm the presence of carbohydrates and proteins, contributing to nutritional value. Uniform weight distribution further reflects proper mixing and standardization of the preparation method. Overall, the formulation appears stable, palatable, and suitable for pediatric use, though further studies on long-term stability, efficacy, and safety are recommended.

6. Conclusion

The study concludes that the herbal pediatric immune booster and appetite stimulant chocolate was successfully formulated using ashwagandha, ajwain, and cardamom with a cocoa butter and dark chocolate base. The formulation showed good organoleptic properties, uniformity, stability, and acceptable taste, making it suitable for pediatric use. The presence of carbohydrates and proteins adds to its nutritional value. Overall, the product can be considered a

promising and palatable herbal formulation, though further studies on stability, safety, and clinical effectiveness are recommended.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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