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A COMPARATIVE PHARMACEUTICO-ANALYTICAL STUDY OF *MUSTAKADI LEHA* AND ITS MODIFICATION INTO GRANULES

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ABSTRACT

Mustakadi Leha, has been described in *Bhaishajya Ratnavali* in *Kasa Chikitsa*, especially in *Kshayaja Kasa*. Its consists of ingredients such as *Musta, Pippali, Draksha* and *Brihati Phala*. It is being consumed by mixing it with honey and ghee in *Leha* form. In current study, an attempt was made to convert *Mustakadi Leha* into an easily consumable, more absorbable form by modifying it into granules. **Aim:** To prepare *Mustakadi Leha* and its granules and to do comparative physico-chemical analysis of *Mustakadi Leha* and its granules. **Method:** The formulation was prepared in accordance with the text *Bhaishajya Ratnavali*. *Avaleha Kalpana* and its conversion into granules are the pharmaceutical processes included in this study. Organoleptic, physico-chemical analysis of *Mustakadi Leha* and its modified granules were carried based on API standard reference. **Observation and Results:** Modifying the preparation *Mustakadi Leha* into *granules* allows for experimentation with different ingredients and ratios, enabling the development of granules with targeted pharmaceutical study. Analytical evaluation of *Mustakadi Leha* and *Mustakadi granules* found satisfactory. **Conclusion:** The pharmaceutico- analytical study comparing *Mustakadi Leha* and its modified granules has revealed important differences in their preparation methods. *Mustakadi Leha*, prepared without heat treatment, likely preserves the natural properties and delicate constituents of its herbal ingredients. Conversely, *Mustakadi* granules, subjected to heating during formulation, may undergo compositional changes, resulting in the

absence of acid-insoluble ash. Furthermore, the study revealed significant differences in sugar content between *Mustakadi Leha* and *Mustakadi* granules, making the *Leha* a more favorable option for individuals concerned about their sugar intake.

KEYWORDS: *Mustakadi Leha, Mustakadi* granules, *Bhaishajya Ratnavali, Kshayaja Kasa.*

INTRODUCTION

Traditional herbal formulations have been an integral part of healthcare systems across the world for centuries. These formulations, rooted in ancient knowledge and practices, offer holistic approaches to healing and wellness. Among such formulations, *Mustakadi Leha,* is an herbal preparation described in the *Bhaishajya Ratnavali*, holds significance in Ayurvedic medicine, particularly in the context of *Kshayaja Kasa* treatment.[1] *Mustakadi Leha* comprising the ingredients *Musta*, *Pippali*, *Draksha*, and *Brihati Phala* and it is consumed after blending with honey and ghee.

However, as medical science advances and consumer preferences evolve, there arises a need to adapt these traditional formulations for modern consumption patterns while preserving their therapeutic efficacy. In this pursuit, the transformation of *Mustakadi Leha* into granules presents an intriguing opportunity. The conversion into granules not only facilitates ease of consumption but also potentially enhances the bioavailability of the herbal constituents, leading to improved therapeutic outcomes.

The objectives encompass the preparation of both the traditional *Mustakadi Leha* and its modified granules, followed by an in-depth physico-chemical analysis to unveil their inherent characteristics. By drawing comparisons between *Mustakadi Leha* and its granular counterpart, valuable insights can be garnered into the changes induced by the modification process. The results obtained from this study are poised to contribute to the broader discourse on modernizing traditional herbal formulations while preserving their essence and efficacy.

AIMS AND OBJECTIVES

- To prepare *Mustakadi Leha* and its granules.
- To do comparative Physico-Chemical analysis of *Mustakadi Leha* and its granules.

MATERIALS AND METHODS

PHARMACEUTICAL STUDY

Mustakadi Leha

The formulation was prepared in accordance with the text *Bhaishajya Ratnavali*. *Avaleha Kalpana* and its conversion into granules are the pharmaceutical processes included in this study.

Source of Drugs

1. *Musta* – Collected from Alva's Pharmacy Mijar, Moodubidire.
2. *Pippali* – Collected from Alva's Pharmacy Mijar, Moodubidire.
3. *Draksha* – Purchased from the local market, Moodubidire.
4. *Brihati Phala* - Fresh fruits were gathered from the plants on the outskirts of Moodubidire.
5. *Ghrita* - Purchased from the local market, Moodubidire.
6. *Kshoudra* - Purchased from the local market, Moodubidire.
7. *Khanda Sharkara* - Purchased from the local market, Moodubidire.

- All the raw drugs were identified by the experts from the Department of Dravya Guna, Alva's Ayurveda Medical College, Moodubidire.
- Pharmaceutical study was carried out in Laboratory, Department of Rasashastra and Bhaishajya Kalpana in Alva's Ayurveda Medical College, Moodubidire.

Preparation of *Mustakadi Leha*

Reference: *Bhaishajya Ratnavali*, Chapter, 15/ 25 Method: *Anagni Siddha Avaleha.*

MATERIALS AND METHOD

Vessels, bowls, spatula, weighing machine and measuring jar, *Khalwa Yantra*, mixer grinder, container.

Table 01: Ingredients of *Mustakadi Leha.*

Sl. No	Name of the drug	Botanical name	Family name	Parts used	Quantity taken
1	*Musta*	*Cyperus rotundus* L.	Cyperaceae	Rhizome	90 g
2	*Pippali*	*Piper longum* L.[2]	Piperaceae	Fruit	90 g
3	*Draksha*	*Vitis vinifera* L.[3]	Vitaceae	Fruit	90 g
4	*Brihati Phala*	*Solanum torvum* Sw.[4]	Solanaceae	Fruit	90 g
5	*Ghrita*	-	-	-	180 g
6	*Kshoudra*	-	-	-	180 g

Practical – 1

Procedure

- Prior to the preparation, all of the ingredients were weighed and measured separately.
- The drugs *Musta*, *Pippali*, *Draksha*, and *Brahati Phala* were grounded into the finest form using the *Khalwa Yantra.*
- Subsequently, the required quantity of *Ghrita* was added, and all of the ingredients were thoroughly blended together.
- Once properly mixed, it was combined with the specified amount of *Kshoudra* and *Mardana* was done until *Samyak Siddhi Lakshana* of *Leha* was achieved.
- This was transferred to an airtight container to prevent spoiling.

Preparation of *Mustakadi* Granules

Reference: *Anubhoota* Method: *Khanda Kalpana.*

MATERIALS AND METHOD

Vessels, bowls, weighing machine and measuring jar, *Khalwa Yantra*, mixer grinder gas stove, *Kora* cloth, spatula, sieve and container.

Table 02: Ingredients of *Mustakadi granules.*

Sl. No.	Drug	Botanical name	Family name	Parts used	Quantity taken
1	*Musta*	*Cyperus rotundus* L.	Cyperaceae	Rhizome	75 g
2	*Pippali*	*Piper longum* L.	Piperaceae	Fruit	75 g
3	*Draksha*	*Vitis vinifera* L.	Vitaceae	Fruit	75 g
4	*Brihati Phala*	*Solanum torvum* Sw.	Solanaceae	Fruit	75 g
5	*Ghrita*	-	-	-	150 ml for *Bharjana* and 150 ml as *Sneha Dravya*
6	*Khanda Sharkara*	*Saccharum officinarum* L.[5]	-	-	1200 g
7	*Jala*	-	-	-	1200 ml for *Kashaya* and 900 ml for dilution of *Khanda Sharkara*

Practical – 2

Procedure.

Poorva Karma

- The ingredients *Draksha* and *Brihati Phala* had soaked for two hours in separate bowls of water prior to the *Pradhana Karma*. Then pounded it in *Khalwa Yantra* to make a fine paste. This paste was fried in a sufficient amount of *Ghrita* and kept it aside.

- With the help of a *Khalwa Yantra*, *Musta* and *Pippali* were ground into a coarse powder (*Kashaya Churna*) form. *Kashaya* was then made by adding 8 times as much water and heated in *Mandagni* and then reduced into1/4th. After cooling, the vessel was removed from the fire and filtered through a *Kora* cloth.
- *Khanda Sharkara* was ground into a fine powder in the *Khalwa Yantra* prior to the *Pradhana Karma*.

Pradhana Karma

- A wide-mouthed stainless steel vessel was taken with *Jala*. It was heated and added with *Khanda Sharkara* which had already been pounded. Then it was well-stirred to dissolve completely. Later it was sieved.
- To this solution already prepared *Kashaya* was poured and heated in *Mandagni*.
- It gradually began to boil and was reduced to the consistency of a single thread. Previously made *Ghrita Bharjita Kalka* was added immediately. Constant stirring was performed to achieve proper mixing.
- When it reached *Asanna Paka Lakshana*, the appropriate amount of *Ghrita* was added to this and constantly stirred until it reached the consistency of *Khanda Paka* of 3-4 thread consistency.
- Once the *Paka* was achieved, immediately the vessel was taken out of the fire.

Paschat Karma

- The obtained mass of *Khanda Paka* was sieved to attain uniform-sized granules. This was transferred to an airtight container to prevent spoiling.

After the completion of Pharmaceutical study samples of both *Mustakadi Leha* and *Mustakadi* granules had send for Analytical Study at SDM Centre for Research in Ayurveda and Allied sciences, Kuthpady, Udupi, Karnataka State.

OBSERVATION AND RESULTS

PHARMACEUTICAL STUDY

Observation on Pharmaceutical Study of *Mustakadi Leha*

Date of commencement: 09/03/2023 Date of completion: 09/03/2023.

09:00 AM: - All the ingredients (*Musta*, *Pippali*, *Draksha*, *Brihati Phala*, *Madhu*, *Ghrita*) was individually weighed and measured.

09:30 AM: - The process of powdering of each ingredient (*Musta*, *Pippali*, *Draksha*, *Brihati Phala*) in *Khalwa Yantra*, was began.

11:25 AM: - The ingredients were taken separately in a mixer grinder and ground into the finest form and filtered in the *Kora* cloth.

12:25 PM: - The fine powder of ingredients weighing 90 g each was individually added to the *Khalwa Yantra* and mixed well.

01: 15 PM: - The *Ghrita* weighing 180 g was added and thoroughly mixed with *Peshani.*

02: 20 PM: - The *Madhu* weighing 180 g was added and firmly mixed.

02: 45 PM: - To ensure proper mixing, continuous trituration was done.

03: 40 PM: - The trituration was ceased, because consistency was attained. 04: 00 PM: - The *Mustakadi Leha* weighing 684 g was packed in an airtight container.

Table 03: Observations For The Practical.

Observations	***Mustakadi Leha***
Total quantity taken	720 g
Total quantity obtained	684 g
Final product quantity expected	648 g
Gain	36 g gain
Total time duration	7 hours

Table 04: Organoleptic characters of *Mustakadi Leha*.

Organoleptic characters	***Mustakadi Leha***
Colour	Dark brown
Odour	Characteristic smell of the ingredients
Taste	*Tikta, Katu, Madhura*
Consistency	Semi solid

Observation on Pharmaceutical Study of *Mustakadi* granules

Date of commencement: 03/03/2023 Date of completion: 03/03/2023

8:30 AM: - The ingredients *Draksha* and *Brihati Phala* of 75 g each were kept in separate bowls containing 300 ml of water for soaking.

9:00 AM: - The ingredients *Musta* and *Pippali* of 75 g each were pounded into a coarse powder form in a *Khalwa Yantra*.

9:30 AM: - Commenced with the *Kashaya* preparation out of *Musta* and *Pippali* of 75g each in 1200 ml of water.

10:00 AM: - The *Kashaya* started to boil.

10:30 AM: - The sugar candy of 1200 g was started to pound in the *Khalwa Yantra*.

11:10 AM: - The pounding of sugar candy was completed.

12:00 PM: - The *Kashaya* preparation was completed. Obtained 300 ml of

Kashaya.

1:15 PM: - In the *Khalwa Yantra*, pre-soaked *Draksha* 110 g and *Brihati Phala* of 100 g began to pounded.

1:20 PM: - The pounding was completed.

2:00 PM: - The paste *Draksha* and *Brihati Phala* of 210 g were added into 150 ml of warm ghee in a steel vessel to begin frying. The characteristic smell of frying in the ghee was observed.

2:45 PM: - The frying of the *Kalka* was completed. The *Kalka* was black in colour.

3:00 PM: - A wide-mouthed stainless steel vessel filled with water of 900 ml was kept over the stove.

3:15 PM: - Started blending the water with *Khanda Sharkara* powder of 1200 g. 3:30 PM: - The solution was completely mixed, so it was filtered into another vessel.

3:45 PM: - The already prepared *Kashaya* of 300 ml was added into the solution while it was being heated up.

4:00 PM: - The solution began to boil. 4:30 PM: - The froth began to appear.

4:45 PM: - The solution achieved one-thread consistency. 5:00 PM: - The *Kalka* was added to the solution.

5:15 PM: - After adding *Kalka*, the foam was more apparent. 5:45 PM: - The solution was attained two thread consistency.

5:55 PM: - The *Apsumajjati* test was carried out and observed the contents were sinking and settling at the bottom of the water.

5:55 PM: - The *Ghrita* of 150 ml was added to the *Leha*.

6:05 PM: - When the consistency reached three threads, the contents began to separate from the vessel, and the characteristic smell was observed.

6:15 PM: - The *Leha* had achieved granular consistency, and the stove had been turned off.

6:20 PM: - The vessel was transferred to a larger vessel filled with water and continuously stirred to prevent adhering inside the vessel.

6:25 PM: - The granules were obtained by passing the contents through a sieve (mesh number 60) into a clean plate.

6:30 PM: - The contents that could not pass through the sieve were pounded in a vessel with *Peshani* and sieved.

6:40 PM: - After sieving, the granules were left to cool under the fan.

7:00 PM: - Granules of 684 g were obtained and packed in the containers, and labelling was done

Table 05: Observations for the *Kashaya* preparation.

Observations	***Kashaya***
Total quantity taken	1200 ml
Total quantity obtained	300 ml
Final product expected quantity	300 ml
Gain / loss	Nil (900 ml loss due to evaporation)
Total time duration	3 hours

Table 06: Organoleptic characters of the *Kashaya.*

Organoleptic characters	***Kashaya***
Colour	Brown
Odour	Characteristic smell of the ingredients
Taste	*Katu, Tikta, Kashaya*
Consistency	Liquid form

Table 07: Observations for the practical.

Observations	***Mustakadi* granules**
Total quantity taken	1800 g
Total quantity obtained	1530 g
Final product expected quantity	1440 g
Gain	90 g gain
Total time duration	10 hours 30 minutes

Table 08: Organoleptic characters of *Mustakadi* granules.

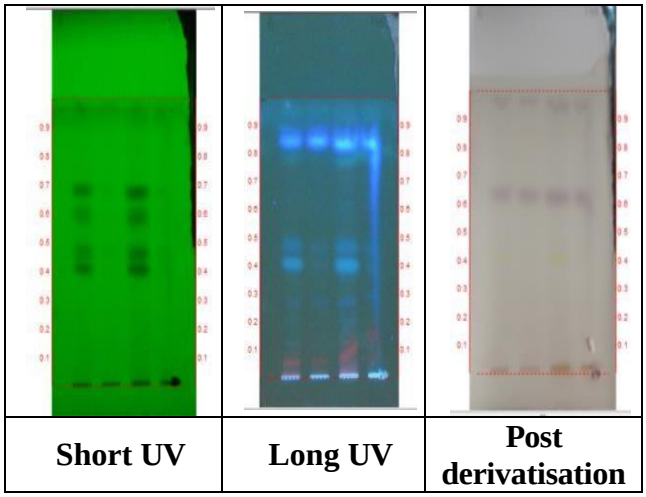
Organoleptic characters	***Mustakadi* granules**
Colour	Brown
Odour	Characteristic smell of the ingredients
Taste	*Madhura, Tikta, Katu Rasa*
Consistency	Granular form

ANALYTICAL STUDY

Physico-Chemical analysis of *Mustakadi Leha* and its granules were carried out at SDM Centre for Research in Ayurveda and Allied sciences, Kuthpady, Udupi, Karnataka State.

Table 09: Results of Standardization Parameters.

Parameters	Result n = 3 (% w/w)	
	MUSTAKADI LEHA	***MUSTAKADI* GRANULES**
pH	7.0	-
Loss on drying	8.71±0.01	-
Total ash	2.7±0.39	0.24±0.00
Acid insoluble ash	0.17±0.00	0.0±0.00
Total sugar	42.0	70.0
Reducing sugar	34.52	-
Non reducing sugar	7.48	-
Total solids	90.0	-
Bulk density	-	0.53
Carr's index	-	14.0(Good flow).HR 1.17 (Good)
Alcohol soluble extractive value	-	22.96 ± 0.02
Water soluble extractive value	-	80.35±0.01



Short UV	**Long UV**	**Post derivatisation**

Track 1 – *MUSTAKADI LEHA*– 4µl

Track 2 – *MUSTAKADI* GRANULES– 4µl Track 3 – *MUSTAKADI LEHA*– 8µl

Track 4 – *MUSTAKADI* GRANULES– 8µl

Solvent system – Toluene: Ethyl acetate (7.0: 3.0)

Figure 1: HPTLC photo documentation of ethanol extract of *Mustakadi Leha* and *Mustakadi* Granules.

Table 10: Rf values of sample of Ethanol extract of *Mustakadi Leha and Mustakadi* Granules.

Short UV		Long UV		Post derivatisation	
Mustakadi Leha	***Mustakadi* Granules**	***Mustakadi Leha***	***Mustakadi* Granules**	***Mustakadi Leha***	***Mustakadi* Granules**
-	-	0.05 (F. red)	0.05 (F. red)	-	-
-	-	0.13 (F. blue)	-	-	-
-	-	0.27 (F. blue)	0.27 (F. blue)	-	-
0.40 (Green)	-	0.40 (F. blue)	0.40 (F. blue)	0.40 (Yellow)	-
0.47 (Green)	-	0.46 (F. blue)	0.46 (F. blue)	-	-
0.59 (Green)	-	-	-	-	-
-	-	0.62 (F. blue)	-	0.62 (Purple)	0.62 (Purple)
0.68 (Green)	-	-	-	-	-
-	-	0.77 (F. blue)	-	-	-
0.85 (Green)	-	0.84 (F. blue)	0.84 (F. blue)	-	-

*F – Fluorescent; L –Light; D – Dark, Rf 0.14-Jeediflavone.

Remarks

The analytical values of given sample ***Mustakadi Leha* and *Mustakadi* granules** has been standardized as per standard testing protocol. Results of standardization parameters are presented in respective tables and figures. Rf 0.14 ± 0.04 could be Jeediflavone.

2.1. Ingredients

2.2. Ingredients pounded and kept ready

2.3. *Musta Churna* was added to *Khalwa Yantra*

2.4. *Pippali Churna* was added

2.5. *Brihati Phala Churna* was added

2.6. *Draksha* paste was added

2.7. *Ghrita* was added

2.8. *Madhu* was added

2.9. Continuous *Mardana* was carried out

2.10. Final product *Mustakadi Leha*

2.11. *Mustakadi Leha* weighed

2.12. Stored in a container

Figure 2: Mustakadi Leha Photographs.

3.1. Ingredients

3.2. *Brihati Phala* and *Draksha* kept for soaking

3.3. *Musta*, *Pippali* and *Jala* kept ready for *Kashaya* preparation

3.4. *Kashaya* filtration

3.5. Filtered *Kashaya*

3.6. *Brihati Phala*, Draksha and *Ghrita*

3.7. Added *Ghrita* to vessel for *Bharjana*

3.8. Added the ingredients for *Bharjana*

3.9. *Kalka* obtained after *Bharjana*

3.10. Kept ready the ingredients for granule preparation

3.11. Added powdered *Khanda Sharkara* to *Jala*

3.12. *Khanda Shrakara* diluted

3.13. Filtered the solution to remove impurities

3.14. Added *Kashaya* to the solution

3.15. Solution kept for boiling

3.16. Boiling stage

3.17. Added *Kalka* to the solution

3.18. Vigorous mixing

3.19. Added *Ghrita*

3.20. Continued mixing

3.21. *Paka* attained

3.22. Vessel transferred to water media for cooling

3.23. Contents transferred through the sieve to obtain the uniform sized granules

3.24. Contents adhered to the vessel has pounded with *Peshani* and sieved

3.25. Final Product *Mustakadi* granules

3.26. Stored in an airtight container

Figure 3: Mustakadi Granules Photographs.

DISCUSSION

DISCUSSION ON PHARMACEUTICAL STUDY

The modification of *Mustakadi Leha* into *Mustakadi* granules introduces some key differences in the preparation and ingredients, which can lead to various advantages and benefits. Granules are easier to handle and transport compared to sticky *Leha*. Granules can be stored in a compact form and are more convenient to take as they do not require any special preparation or mixing before consumption. The granules offer more precise dosing options. One can easily measure and consume the desired quantity, whereas *Leha* is a sticky, semi-solid preparation that lacks the same uniformity as granules. Measuring an accurate quantity of *Leha* can be challenging, as it may not have a consistent density, and estimating the correct dosage might be imprecise. Without specific measuring tools, determining the exact amount of *Leha* to consume may rely on subjective judgments, leading to potential variations in dosing.

The change in preparation method, particularly the use of ghee and sugar syrup, could alter the taste and texture of the final product. Some people may prefer the taste of the granules over the *Leha*, making it more palatable and easier to consume. The process of boiling and ghee frying ingredients in the granule preparation might enhance the bioavailability and

effectiveness of active compounds, potentially improving the therapeutic benefits of the product. Modifying the preparation method allows for experimentation with different ingredients and ratios, enabling the development of granules with targeted pharmaceutical study.

DISCUSSION ON ANALYTICAL STUDY

Organoleptic Characteristics

The taste of *Mustakadi Leha* is described as *Tikta* (bitter), *Katu* (pungent), and *Madhura* (sweet). On the other hand, *Mustakadi* granules have a taste profile of *Madhura* (sweet), *Tikta* (bitter), and *Katu Rasa* (pungent taste). The differences in taste can be attributed to the variations in ingredient proportions and the incorporation of sugar candy in the granule preparation. While the other ingredients contribute to the bitterness and pungency in the granules. *Mustakadi Leha* is described as a semi-solid formulation, indicating its sticky nature, whereas *Mustakadi* granules are in a granular form. The difference in consistency is a direct result of the formulation modification. The removal of honey and incorporation of sugar candy in the granules may have contributed to their solid and granular structure, making them easier to handle and consume compared to the sticky nature of *Leha*.

pH Value

A pH value of 7 indicates neutrality. In the context of *Mustakadi Leha*, it suggests that the product has a neutral pH level, meaning it is neither acidic nor basic. Neutral pH is often desirable in confectionery because it helps maintain the overall balance of flavors and ensures that the product is not too sour or alkaline.

Loss On Drying

The loss on drying value of *Mustakadi Leha* was 8.71±0.01 % w/w which indicates the presence of moisture contents. Since the total moisture content in the mixture is approximately 62.64g, and we know the weights of honey and ghee in the mixture (both 180g each), we can conclude that a significant portion of the moisture content comes from honey and ghee, along with the moisture present in the remaining dry ingredients of the *Mustakadi Leha*, that is *Musta*, *Pippali*, *Draksha* and *Brihati Phala*.

Total Ash

The total ash value of *Mustakadi Leha* was 2.7±0.39 % w/w and for *Mustakadi* Granules was 0.24±0.00 % w/w. Typically, organic materials like honey and ghee have very low ash

content. On the other hand, the inorganic components are usually contributed by minerals and salts present in certain herbal ingredients. it is likely that the herbal powders (*Musta*, *Pippali*, *Draksha*, and *Brihati Phala*) are the primary contributors to the total ash value in *Mustakadi Leha*. These herbal ingredients may contain minerals and other inorganic compounds, which increase the total ash content when the mixture is incinerated.

The confectionery method used for preparing the granules involves heating the mixture. The heating process could cause some volatile components to evaporate or undergo chemical changes, potentially leading to a decrease in the total ash content. The specific temperature and duration of heating could impact the ash content of the modified granules.

Acid Insoluble Ash

Mustakadi Leha is prepared without using heat, which suggests that the ingredients are not subjected to high temperatures during the manufacturing process. As a result, the *Leha* retains an acid-insoluble ash value of 0.17±0.00 % w/w, indicating the presence of inorganic or mineral content that is insoluble in acid. This could be due to the presence of natural minerals or other insoluble components in the herbal ingredients used to prepare the *Leha*.

On the other hand, the modified *Mustakadi* granules are prepared using *Agni*. Heat treatment can alter the composition of the herbal ingredients, potentially reducing the inorganic or mineral content. As a result, the modified granules exhibit a lower acid insoluble ash value of zero, indicating the absence of inorganic or mineral residues that are insoluble in acid.

In summary, the difference in acid insoluble ash values between *Mustakadi Leha* and its modified *Mustakadi* granules can be attributed to the use of heat during the preparation of the granules, which likely caused the reduction or elimination of inorganic or mineral content.

Total Sugar

The two products, *Mustakadi Leha* and *Mustakadi* Granules, differ in their sugar content. *Mustakadi Leha* has a total sugar content of 42% w/w, while *Mustakadi* Granules have a higher sugar content of 70% w/w. This indicates that *Mustakadi* Granules have a significantly higher sugar concentration compared to *Mustakadi Leha*. Both *Mustakadi* Leha and *Mustakadi* Granules contain similar sugar-contributing ingredients, which is *Draksha* and other supportive ingredients are *Musta*, *Pippali*, *Brihati Phala*, and Ghee. The difference in sugar content between the two products comes from the use of Honey in *Mustakadi Leha* and

Sugar candy in *Mustakadi* Granules. Honey has a lower sugar content than Sugar candy, which leads to *Mustakadi Leha* having a total sugar content of 42% w/w, while *Mustakadi* Granules have a higher sugar content of 70% w/w. Honey, the sweetening agent in *Mustakadi Leha*, is known for its distinct flavor profile. It provides a unique taste that may be described as rich, floral, and slightly tangy. On the other hand, sugar, used in *Mustakadi* Granules, offers a more straightforward and familiar sweetness without any distinctive flavor notes. The choice between these two sweetening agents can significantly influence the overall taste experience of the product, appealing to different consumer preferences.

Reducing and Non-Reducing Sugars

In the context of *Mustakadi Leha*, the reported value of 34.52% w/w reducing sugar suggests that a significant portion of the formulation consists of these types of sugars. Reducing sugars are easily absorbed by the body and provide a quick source of energy. However, excessive consumption of high amounts of reducing sugars, particularly if not balanced with other nutrients, may contribute to spikes in blood sugar levels and have potential implications for individuals with diabetes or those aiming to regulate their sugar intake.

Non-reducing sugars, such as sucrose, lactose, and maltose, do not have a free carbonyl group and do not readily undergo reduction reactions. The reported value of 7.48% w/w non-reducing sugar in *Mustakadi Leha* suggests that a smaller proportion of the formulation comprises these sugars. Non-reducing sugars typically take longer to break down in the body compared to reducing sugars. They require specific enzymes to be broken down into their constituent monosaccharides before they can be absorbed. This slower digestion and absorption process may result in a more gradual release of energy compared to reducing sugars.

Total Solids

The total solid value of *Mustakadi Leha* being 90% w/w can be considered relatively high. Total solid value refers to the amount of solid substances present in a solution or mixture. In the case of *Mustakadi Leha*, having a total solid value of 90% w/w indicates that it contains a significant amount of solid components compared to the liquid components. This indicates that the mixture contains a substantial amount of solid substances compared to the liquid component. The ingredients such as *Musta*, *Pippali*, *Draksha*, and *Brihati Phala*, contribute to the solid content of the *Leha*. In this formulation, each of the solid ingredients (*Musta*, *Pippali*, *Draksha*, and *Brihati Phala*) is present in a quantity of 90 grams, while honey and

ghee are both present in a quantity of 180 grams each. These solid ingredients likely contribute to the overall solid content of the *Leha*. Honey and ghee, despite being listed as ingredients, are not solid substances. Honey is a viscous liquid, while ghee is a clarified butter that can solidify at room temperature but is typically considered semi-solid or semi- liquid. Therefore, the solid value of the *Leha* would primarily be derived from the solid ingredients rather than the honey and ghee.

Bulk Density

The bulk density of the *Mustakadi* granules is 0.53 g/mL, it means that for every milliliter of volume occupied by the granules, the mass of the granules is 0.53 grams. This value indicates that the granules are relatively light and not very dense. Light granules are easier to handle and transport due to their lower weight. They require less effort to lift, move, and load, which can increase operational efficiency and reduce the risk of injuries. Lighter granules require less energy for transportation, resulting in cost savings on fuel or electricity. Additionally, lower weight can lead to reduced shipping costs, as transportation fees are often calculated based on weight. Light granules tend to have better flowability and can be more easily mixed with other materials. Light granules may have lower stability when exposed to external forces, such as wind or vibration. Light granules may be more susceptible to breakage or attrition during handling, leading to the generation of fines or smaller particles.

Compressibility

A Carr's index of 14 (% w/w) suggests that the *Mustakadi* granules have relatively good flowability. A value below 15 is generally considered favorable for pharmaceutical granules, indicating that they have good compressibility and are less likely to form clumps or bridges during processing. A Hausner's ratio of 1.17 (% w/w) also indicates good flowability. A ratio below 1.25 (% w/w) is typically considered desirable, as it suggests that the granules have low inter-particle friction and can flow easily. So based on the obtained values, it can be inferred that the *Mustakadi* granules exhibit favorable flow properties, with good compressibility and ease of flow. These characteristics are important in various manufacturing processes, such as tablet compression or capsule filling, where a consistent and efficient flow of granules is desired.

Alcohol Soluble Extractive

Mustakadi granules have an alcohol-soluble extractive value of 22.96% w/w. This value indicates that a significant portion of compounds present in the granules can dissolve in

alcohol, suggesting the potential presence of bioactive constituents. While the determination of an optimum extractive value depends on various factors, a value of 22.96% w/w suggests a notable concentration of soluble compounds.

Water Soluble Extractive

A water-soluble extractive of 80.35% w/w for *Mustakadi* granules suggests that this formulation contains a significant amount of water-soluble compounds. The high water-soluble extractive percentage indicates that the active constituents present in *Mustakadi* granules are predominantly soluble in water. This suggests that the formulation may contain a variety of water-soluble compounds such as polysaccharides, flavonoids, alkaloids, and other phytochemicals. Water-soluble compounds are generally responsible for the medicinal properties of herbal formulations. In the case of *Mustakadi* granules, these water-soluble compounds may contribute to its potential digestive benefits, anti-inflammatory effects, and overall therapeutic action. *Mustakadi* granules have more water-soluble extractives than alcohol-soluble extractives, which suggests that the formulation contains a higher concentration of compounds that can dissolve in water compared to those that can dissolve in alcohol. This formulation's active ingredients or constituents are more likely to dissolve and be extracted into water-based solvents rather than alcohol-based solvents. This indicates that water-based solvents would be more effective for extracting the desired compounds from the formulation. The higher water solubility suggests that the water- soluble compounds are more readily available for absorption by the body. This may affect the formulation's efficacy, as the water-soluble components would be more easily absorbed into the bloodstream or reach their target site compared to the alcohol-soluble components.

HPTLC

The provided HPTLC photo documentation, Rf values, and densitograms for *Mustakadi Leha* and *Mustakadi* granules indicate the presence of different separated components in both formulations. Notably, a band with an Rf value of 0.14 ± 0.04 is potentially identified as Jeediflavone in the analysis. Jeediflavone is a chemical component that is primarily found in the plant *Semecarpus anacardium* L.f.[6] But that is not an active pharmaceutical ingredient in both preparations, so to draw accurate conclusions about the components, present in *Mustakadi Leha* and *Mustakadi* granules, further analysis using complementary techniques like mass spectrometry or nuclear magnetic resonance (NMR) spectroscopy should be conducted. These methods can provide more precise information about the chemical

composition of the formulations and help identify the actual compounds present in them.

CONCLUSION

The pharmaceutico-analytical study comparing *Mustakadi Leha* and its modified granules has revealed important differences in their preparation methods. *Mustakadi Leha*, prepared without heat treatment, likely preserves the natural properties and delicate constituents of its herbal ingredients, leading to the presence of an acid-insoluble ash value. Conversely, *Mustakadi* granules, subjected to heating during formulation, may undergo compositional changes, resulting in the absence of acid-insoluble ash. These findings highlight the potential impact of preparation techniques on the formulation's properties.

Furthermore, the study revealed significant differences in sugar content between *Mustakadi Leha* and *Mustakadi* granules, making the *Leha* a more favorable option for individuals concerned about their sugar intake. The flowability of the granules was also found to be favorable, contributing to their ease of handling and administration. Overall, this comparative study provides a valuable foundation for the advancement and optimization of the formulations.

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