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Comparative Micrometric Study of Different Samples of *Swarjika Kshara*

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ABSTRACT

Introduction: *Swarjika Kshara*, an important alkaline formulation in Ayurveda, is traditionally prepared using plant sources such as *Ushtrapriya*, *Rudanti*, and *Lana*. However, regional practices and modern adaptations, including chemically synthesized sodium bicarbonate, have introduced variations in its preparation. This study investigates the organoleptic and micrometric properties of three *Swarjika Kshara* samples—SKU (from *Ushtrapriya*), SKR (from *Rudanti*), and SKM (a market sample)—to establish a comparative profile. **Aim**: The aim is to evaluate and standardize the micrometric characteristics of *Swarjika Kshara* samples prepared from different sources and compare them to a market sample. **Material and Methods**: Three samples—SKU, SKR, and SKM—were evaluated for organoleptic parameters (color, taste, odor, and touch) and subjected to micrometric analysis. Micrometry was performed using a calibrated ocular micrometer to measure crystals such as calcium carbonate, calcium oxalate, phosphate oxalate, and sodium. Chemical reactivity was assessed using distilled water, hydrochloric acid (HCl), and sulfuric acid (H_2SO_4).

Results:

Organoleptic analysis revealed SKU as white, SKR as creamy white, and SKM as whitish-grey with differences in taste, odor, and texture. Micrometric evaluation showed SKU and SKR contained uniform calcium carbonate and oxalate crystals, whereas SKM exhibited smaller, irregular crystals and silica contamination. Sodium was present in SKR and SKM but absent in SKU. **Conclusion**: SKU and SKR adhered more closely to traditional standards, while SKM showed impurities, highlighting the need for standardization. This study provides baseline data for the quality control of *Swarjika Kshara*.

Key Words *Swarjika Kshara, Micrometry study, Calcium oxalate, Calcium carbonate*

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INTRODUCTION

Kshara is an alkaline substance in Ayurveda, obtained from ash of one or more plants, animals and mineral products[1]. The term used in modern science for "*Kshara Vargiya Dravya*" is "alkali". The word "Alkali" comes from the Arabic term "alqaliy," which means "the calcined ashes," highlighting the initial source of alkaline substances. Alkali primarily consists of Sodium, Potassium, and Calcium. It is produced from calcium sources such as Calcium, Limestone, and organic materials, along with plant ashes that

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contain Sodium, Potassium, Magnesium, Carbonate, Calcium oxide, and Silica[2].

Swarjika Kshara is included in all *Kshara* groups mentioned in classics like *Kshara Dvaya*, *Ksharatraya*, *Ksharapanchaka* and *Ksharashtaka*[3]. The preparation of *Swarjika Kshara*, as described in classical Ayurvedic texts, varies depending on the region and the source of material used. Plants such as *Ushtrapriya*, *Lana* and *Rudanti* are utilized to extract the *Swarjika Kshara* in Rasatarangini[4], Rasatantrasara Evam Siddhaprayogasamgraha[5] and Ayurvediya Rasashastra[6] respectively. According to API, *Swarjika Kshara* is impure sodium bicarbonate[7]. Also in the present era, chemically prepared sodium bicarbonate is used as *Swarjka Kshara*.

Micrometry is a study that involves measuring microscopic structures to analyze their size and dimensions. In the context of *Swarjika Kshara*, micrometry is applied to evaluate which types of crystals and other content are present in a different sample of *Swarjika Kshara*. This study helps standardize the preparation process and assess its quality, which directly impacts the therapeutic efficacy of *Kshara* formulations.

Taking note of above references, various types of methods and plants were found for the preparation of *Swarjika Kshara*. So, in this study three samples of *Swarjika Kshara* were selected, one sample was prepared from *Ushtrapriya* (SKU) second sample was prepared from *Rudanti* (SKR) and third sample was a market sample (SKM). The present study aims to evaluate and establish the pharmacognostical and micrometric variations among these three samples.

MATERIALS AND METHODS

A microscopic evaluation of *Swarjika Kshara* prepared from *Ushtrapriya*, *Rudanti*, and its market sample was conducted to generate micrometric data.

Preparation of *Swarjika Kshara*

Swarjika Kshara from *Ushtrapriya* and *Rudanti* was prepared in the pharmaceutical laboratory of the upgraded department of Rasashastra and Bhaishajya Kalpana, Vadodara, Gujarat.

Swarjika Kshara from *Ushtrapriya* and *Rudanti* were prepared as per the reference of Rasatarangini with 3 hours and 3+12 hours sedimentation time respectively. For the preparation of ash, fresh *Ushtrapriya Panchanga* and *Rudanti Panchanga* were collected, cleaned, dried and burnt completely. For the preparation of *Ksharajala*, one part ash and eight parts potable water (v/v) were taken in s.s. vessel, macerated thoroughly and kept undisturbed for three hours for *Ushtrapriya Ksharajala* and eighteen hours for *Rudanti Ksharajala*. After sedimentation time, clear liquid was drained out through a rubber tube. Filtered 7 times through three folded cotton cloth and *Ushtrapriya Ksharajala* and *Rudanti Ksharajala* were obtained. For the preparation of *Kshara*, *Ksharajala* was taken in s.s. vessel and heated over the gas stove till the entire water portion gets evaporated completely. *Swarjika*

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Kshara from *Ushtrapriya* (SKU) and *Swarjika Kshara* from *Rudanti* (SKR) were collected and stored in airtight containers.

Procurement of market sample

A market sample of *Swarjika Kshara* was procured from the local market of Vadodara, Gujarat.

Organoleptic evaluation

Organoleptic characteristics such as color, odor, taste and touch were noted down by sensory observations for 3 samples of *Swarjika Kshara* (SKU, SKR and SKM).

Micrometry study

Micrometry study of SKU, SKR and SKM was done to evaluate comparative micrometric data of samples at the Pharmacognosy Laboratory, Institute of Teaching and Research in Ayurveda, Jamnagar,

Identification and measurement of the length and width of different crystals with their contents including powder characters were taken into consideration for micrometric evaluation. The powder of *Swarjika Kshara* was spread on glass slides and processed with distilled water, hydrochloric acid and sulphuric acid to observe different content under a binocular microscope at different magnifications[8,9].

OBSERVATIONS AND RESULTS

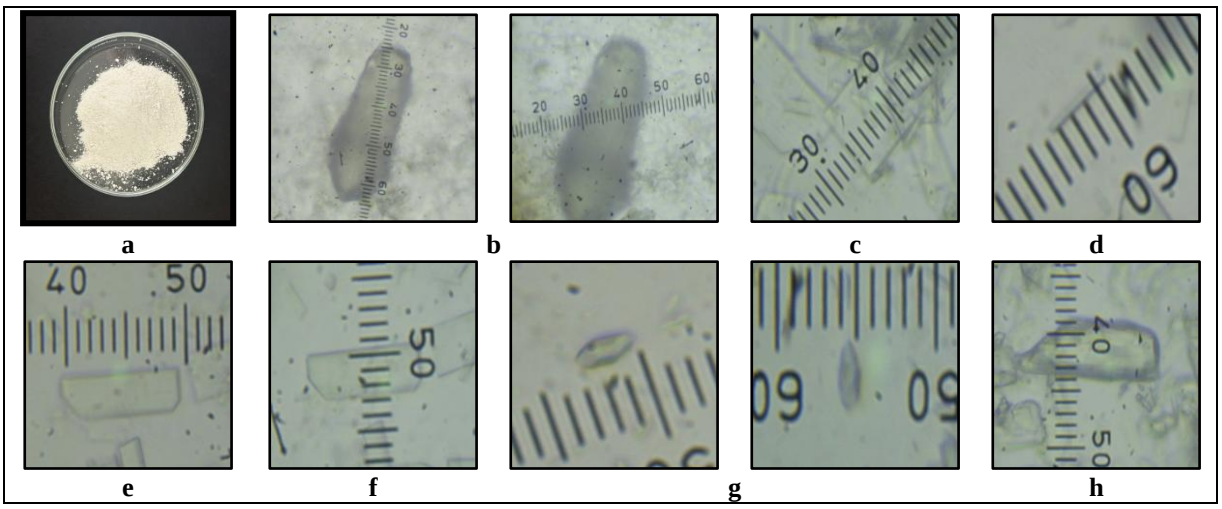
Organoleptic evolution

Organoleptic characteristics of 3 samples of *Swarjika Kshara* (SKU, SKR and SKM) mentioned in table 1.

Table 1 Organoleptic characters of different samples of *Swarjika Kshara*

Parameters	Sample 1 (SKU)	Sample 2 (SKR)	Sample 3 (SKM)
Colour	White	Cremish white	Whitish dark grey
Taste	Salty, light acrid	Saltier, Spread watery	Light salty
Odour	Light alkali	Characteristic	Characteristic
Touch	Fine coarsely	Fine coarsely	Coarse

Micrometry evolution: 1) Powder microscopy and micrometry characters of *Swarjika Kshara* prepared from *Ushtrapriya* (*Fagonia Cretica* Linn.) (Figure-1)



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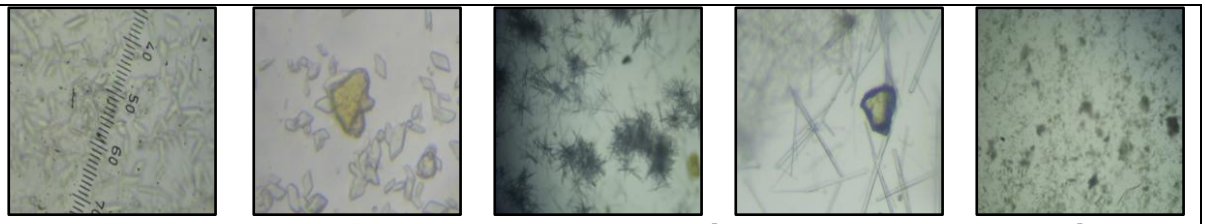
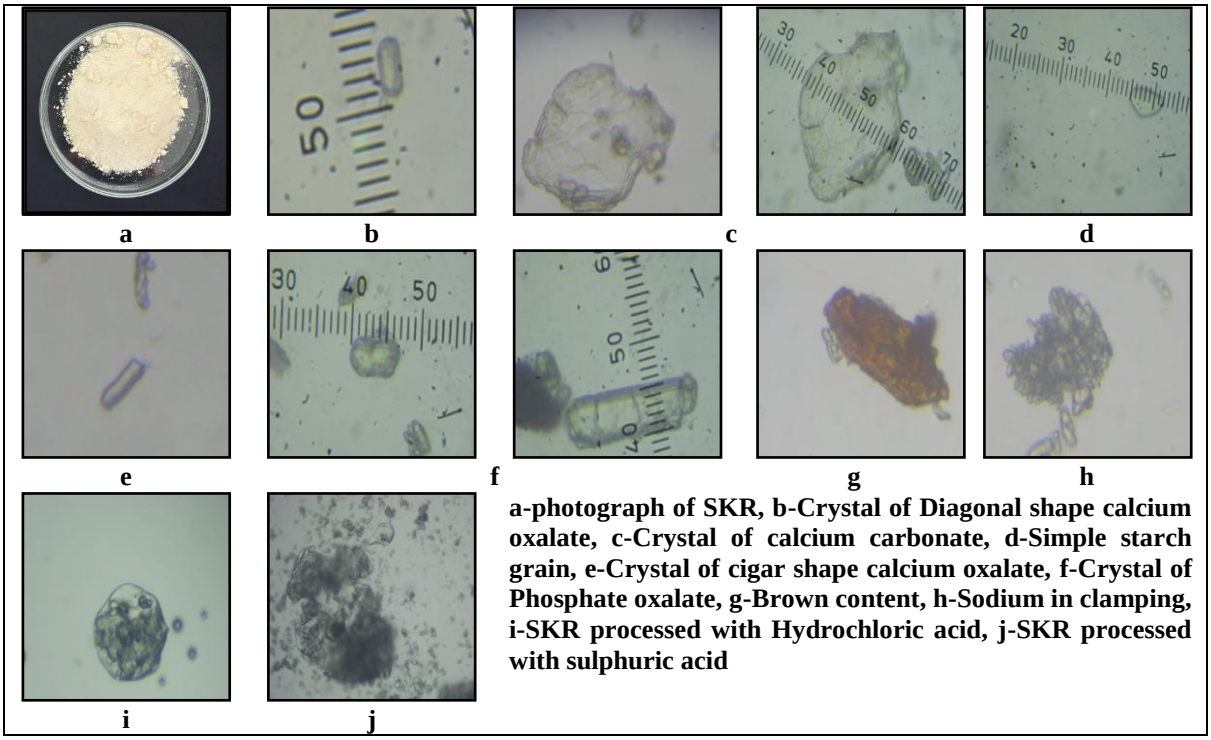


i j k l

a-photograph of SKM b-Crystal of calcium carbonate, c-Crystal of Square shape calcium oxalate, d-Crystal of Rod shape calcium oxalate, e-Crystal of diagonal shape calcium oxalate, f-Crystal of diagonal shape calcium oxalate, g-Crystal of rhomboidal shape calcium oxalate, h-Crystal of Phosphate oxalate, i-Simple starch grain, j-Yellow content, k-SKU processed with Hydrochloric acid, l-SKU processed with sulpuric acid

Figure 1 Micrometry characters of *Swarjika Kshara* prepared from *Ushtrapriya*



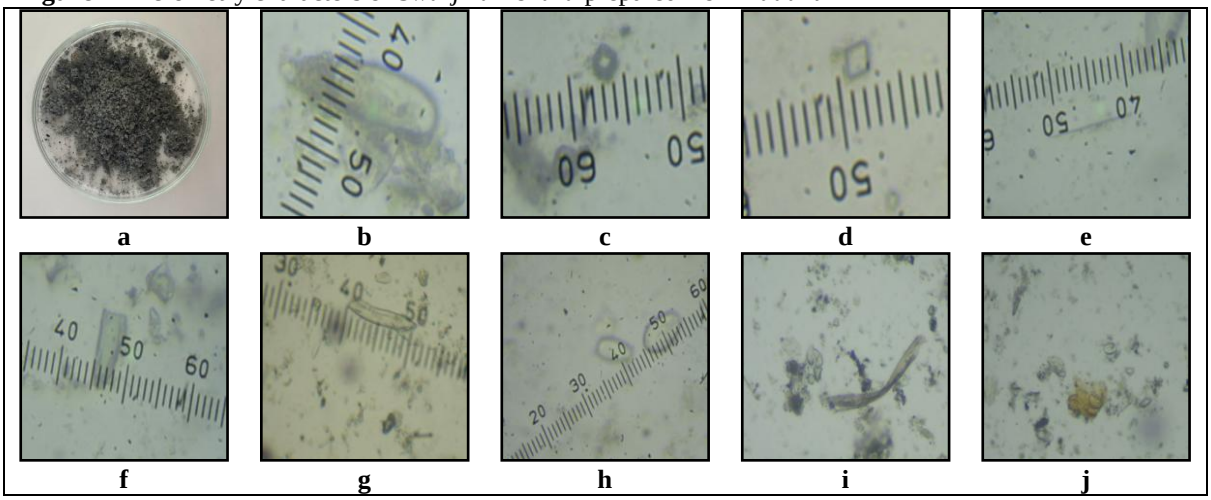
a b c d

e f g h

i j

a-photograph of SKR, b-Crystal of Diagonal shape calcium oxalate, c-Crystal of calcium carbonate, d-Simple starch grain, e-Crystal of cigar shape calcium oxalate, f-Crystal of Phosphate oxalate, g-Brown content, h-Sodium in clamping, i-SKR processed with Hydrochloric acid, j-SKR processed with sulphuric acid

Figure 2 Micrometry characters of *Swarjika Kshara* prepared from *Rudanti*



a b c d e

f g h i j

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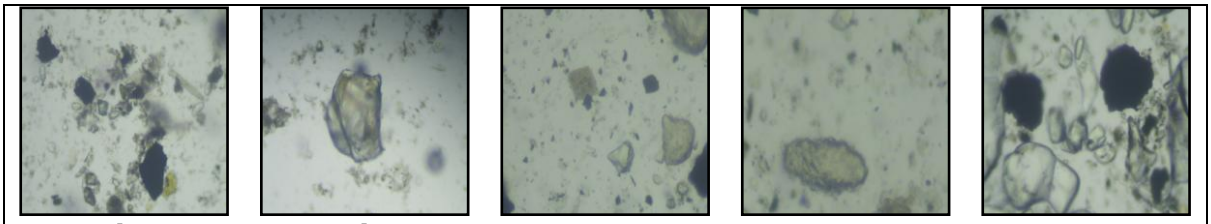

k l m n

a-Photograph of SKM, b-Crystal of calcium carbonate, c-Crystal of square shape calcium oxalate, d-Crystal of prismatic shape calcium oxalate, e-Crystal of needle shape calcium oxalate, f-Crystal of Phosphate oxalate, g-Sodium, h-Simple starch grain, i-fragments of fibres, j-Yellow content, k-Mineral deposition, l-silica deposition, m-SKM processed with Hydrochloric acid, n-SKM processed with sulphuric acid

Figure 3 Micrometry characters of market sample of *Swarjika Kshara*

(a) Dissolved in H_2O

Diagnostic characters : Calcium carbonate, calcium oxalate, phosphate oxalate, simple starch grain, yellow content.

(b) Dissolved in HCL

Diagnostic characters : The calcium oxalate crystals dissolved in HCL and revealed star-like structures under the microscope.

(c) Dissolved in H_2SO_4

Diagnostic characters : The calcium carbonate crystals dissolved

2) Powder microscopy and micrometry characters of *Swarjika Kshara* prepared from *Rudanti* (*Cressa Cretica* Linn.) (Figure-2)

(a) Dissolved in H_2O

Diagnostic characters : Calcium carbonate, calcium oxalate, phosphate oxalate, sodium simple starch grain, brown content.

(b) Dissolved in HCL

Diagnostic characters : Calcium oxalate completely dissolved in HCl, leaving behind phosphate, sodium, and calcium carbonate

(c) Dissolved in H_2SO_4

Diagnostic characters : The sample dissolved with a hissing sound, and there was a noticeable clumping of calcium carbonate, while sodium and phosphate remained.

3) Powder microscopy and micrometry characters of market sample of *Swarjika Kshara* (Figure-3)

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(a) Dissolved in H_2O

Diagnostic characters : Calcium carbonate, calcium oxalate, phosphate oxalate, sodium simple starch grain, yellow and brown content, mineral deposition, silica deposition.

(b) Dissolved in HCL

Diagnostic characters : Dissolved with bubbling and hissing sounds, the clumping of crystals increased after the reaction. Under the microscope (10x), starch grains, silica, and calcium carbonate crystals (0.7 × 0.3 µm) were identified.

(c) Dissolved in H_2SO_4

Diagnostic characters : Dissolved with bubbling and hissing sound, calcium oxalate, phosphate crystals, and sodium dissolving.

Minerals and silica did not dissolve in either HCl or sulfuric acid

Micrometric measurements of different samples of *Swarjika Kshara* were observed under a binocular microscope, at 40 x which were enlisted in table no 2

Table 2 Micrometric measurements of different structures of *Kshara* under a binocular microscope

Parameters	Sample 1 (SKU)	Sample 2 (SKR)	Sample 3 (SKM)
Calcium carbonate	4.1×1.6 µm	3.2 × 2.1 µm	1.2 × 0.4 µm
Calcium oxalate			
Square shape	0.7 × 0.7 µm	-	0.2 × 0.2 µm
Diagonal shape	1.0 × 0.3 µm	0.3 × 0.1 µm	-
Rod shape	0.4 × 0.1µm	-	-
Rhomboidal shape	0.3 × 0.1 µm	-	0.3 × 0.1 µm
Cigar shape	-	0.3 × 0.1 µm	-
Prismatic shape	-	-	0.2 × 0.2 µm
Needle shape	-	-	1.2 µm
Phosphate oxalate	1.7 × 0.4 µm	0.7 × 0.4 µm 2.0 × 0.5 µm	0.8 × 0.3 µm
Sodium	-	Founded	1.2 × 2.0 µm (10x)
Simple starch grain	0.2 μm^2	0.3 μm^2	0.3μm^2

DISCUSSION

Micrometric studies of SKU (*Swarjika Kshara* prepared from *Ushtrapriya*), SKR (*Swarjika Kshara* prepared from *Rudanti*), and SKM (*Swarjika Kshara* market sample) were conducted under various chemical reagents using distilled water, hydrochloric acid (HCl), and sulfuric acid (H_2SO_4) to identify and measure different crystals like calcium carbonate, calcium oxalate, phosphate, and sodium.

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For the SKU sample, when dissolved in water, it exhibited the presence of calcium carbonate, calcium oxalate, phosphate oxalate, and simple starch grains. The calcium oxalate crystals showed diverse forms, including square-shaped (0.7 × 0.7 µm), diagonal-shaped (1.0 × 0.3 µm), and rhomboidal-shaped (0.3 × 0.1 µm). Upon dissolution in HCl, the calcium oxalate crystals dissolved, revealing star-like structures under the microscope. The reaction in H_2SO_4 resulted in the dissolution of calcium carbonate crystals, indicating the high sensitivity of samples to strong acids.

In the SKR sample, when dissolved in water, a diverse mineral composition was identified, including calcium carbonate, calcium oxalate, phosphate oxalate, and sodium. Notably, the calcium oxalate crystals included a unique cigar-shaped form (0.3 × 0.1 µm), and the phosphate oxalate crystals measured 1.7 × 0.4 µm, highlighting distinct structural differences from SKU. When treated with HCl, calcium oxalate crystals completely dissolved, leaving behind sodium and phosphate, underscoring the reactivity of these components. Dissolution in H_2SO_4 caused a hissing sound, with clumping of calcium carbonate observed, while sodium and phosphate crystals remained intact.

The SKM sample, when dissolved in water, contained calcium carbonate, calcium oxalate, phosphate oxalate, sodium, and silica deposition. The calcium carbonate crystals were smaller (1.2 × 0.4 µm) compared to the other samples, and the presence of silica suggested possible contamination or added impurities in the market sample. Upon treatment with HCl, bubbling and hissing sounds were noted, with starch grains, silica, and smaller calcium carbonate crystals (0.7 × 0.3 µm) remaining after the reaction. In H_2SO_4, the dissolution of calcium oxalate, phosphate crystals, and sodium was observed, but mineral and silica content resisted dissolution, indicating the presence of impurities not present in the other samples.

Three samples of *Swarjika Kshara*, SKU (*Swarjika Kshara* prepared from *Ushtrapriya*), SKR (*Swarjika Kshara* prepared from *Rudanti*), and SKM (*Swarjika Kshara* market sample) - demonstrate notable differences in their structural properties, and purity. SKU and SKR, showed a more consistent presence of key components such as calcium carbonate, calcium oxalate, and phosphate oxalate. Sodium is only found in SKR. And market sample, showed evidence of contamination or impurities, particularly the presence of silica, along with inconsistent reactions to acid treatments. The presence of impurities such as silica, which did not dissolve in either HCl or H_2SO_4.

CONCLUSION

In this study, first attempt has been made to generate the micrometric profile of 3 different samples of *Swarjika Kshara* (SKU, SKR and SKM) on the basis of organoleptic and micrometric evaluation. The findings can be further used for the standardization purpose of

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Swarjika Kshara. The limitation of this study is that the *Swarjika Kshara* of plant origin and mineral origine may vary from place to place.

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