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Research Article

COMPARISON OF PHYSICO-CHEMICAL PROPERTIES OF RAW AND PURIFIED SULPHUR

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	ABSTRACT
<p>*Correspondence</p> <p>Dr. R. S Sawant Assistant Professor, Department of Rasashastra and Bhaishajya Kalpana, KGMP Ayurvedic College, Charni Road, Mumbai, India</p> <p>DOI: 10.7897/2321-6328.02110</p> <p>Article Received on: 06/01/14 Accepted on: 10/02/14</p>	<p>Sulphur is one of the most important elements which are classified as uparasa (categorization according to Ayurved texts). In natural (impure) form it causes disorders like kushta (skin diseases), hyperthermia, dizziness and weakness, vitiation of pitta dosha and loss of luster of skin. It was observed that physico-chemical changes are associated with change in its medicinal properties. Many procedures for purification of sulphur are mentioned in Ayurvedic texts but there is need of procedure to identify purified sulphur. In present study sulphur purification was carried out using cow milk and ghee as media at 3 times (stage) and compared with raw sample. The comparison revealed perceptible changes in physicochemical parameters between raw and processed sulphur as well as ghee.</p> <p>Keywords: Sulphur, physicochemical changes, Uparasa, Shodhana</p>

INTRODUCTION

The science and art of pharmacy of Ayurveda is perhaps the oldest in the world and its development has been parallel to that of the science and art of medicine in India. The progress of Iatrochemistry (Rasashastra) or art of preparing metals and metallic compounds as well as of salts (inorganic or organic) for medicinal use was rather slow in early days of Hindu medicine but subsequently it flourished. Chakrapani was first to mentioned processing of minerals with extracts of herbs as well as animals origin products. Sulphur is one of the most important elements which are classified as uparasa¹ (categorization according to Ayurved texts). It has been never used in its natural but in purified form as in natural (impure) form its causes disorders like kushta (skin diseases), hyperthermia, Dizziness, weakness, vitiation of pitta dosha and loss of luster of skin.² Many procedures for purification of sulphur are available in Ayurvedic texts but there is need of procedure to identify purified sulphur. At present there are no parameters available for assessment of Shodhana (purification). After purification some modifications in properties of any element must be take place which can cause change in its physico-chemical properties. Generally it was observed that physico-chemical changes are associated with change in its medicinal properties. Considering this need, proposed study named "Comparison of physico-chemical properties of raw and purified sulphur" was carried out.

Aims and Objectives

To observe the difference in physicochemical characteristics of sulphur before and after purification

MATERIALS AND METHODS

The materials used in this process were as follows:

- Sulphur (Amalasar Gandhak - Crystalline form of Sulphur) – 1 part
- Ghee (clarified butter) – 1 part
- Cow milk – 4 parts

Sulphur Purification

Method described in text 'Ayurved Prakash' and 'Rasendra Sar Sangraha' was adapted for this study.³ For this purpose sulphur and ghee were taken in equal quantity and milk four times of sulphur. Sulphur was melted in iron pot smeared with ghee, then strained in a pot containing cow milk (lukewarm) by cotton cloth and collected when cooled. The procedure was repeated for three times. It was then washed with warm water several times and dried, then kept for use.

OBSERVATION AND RESULTS

Below tables are showing the properties of sulphur stages. Control indicates Raw Sulphur and Sulphur stages means sulphur obtained after processing it in ghee and milk for first, second and third respectively. Comparative Organoleptic

characters were the following: Rupa (color) was changed from yellow to reddish yellow, Rasa (taste) was changed from slightly bitter to ghee taste, Gandha (odor) changed was characteristic due to the specific properties of the cow ghee and Sparsha (consistency/texture) was smooth as given in [Table 1]

Table 1: Organoleptic Characteristics of Sulphur at various stages

	Control	Stage 1	Stage 2	Stage 3
Colour	Yellow	Yellow and slight red	Yellow	Reddish yellow
Odor	Pungent smell typically of sulphur	Odor decreased, slight ghee smell	Sulphur odor markedly decreased, ghee smell increased	Sulphur odor markedly decreased, ghee smell increased
Taste	Slightly bitter	Slight bitter	Slight bitter	Slightly bitter and ghee taste
Texture	Rough	Smooth	Smooth	Smooth

Consistency of the raw sulphur was brittle which was changed to hard after purification for 3 times. Loss on drying was initially 9.43 % w/w which was increased to 9.52 % w/w as given in [Table 2].

Table 2: Physico-chemical properties of Sulphur at various stages

Test	Control	Stage 1	Stage 2	Stage 3
Flame test	Blue	Blue and reddish	Violet	Blue and violet
Melting point	116°C	117°C	117.1°C	117°C
Solubility in CS ₄	97 %	73 %	74.11 %	75.90 %
Ash value	Nil	Nil	Nil	Nil
Consistency	Brittle	Hard	Hard	Hard
Loss on drying at 110°C	9.43 %	9.35 %	9.45 %	9.52 %

The average particle size of raw sulphur was $26.12 \pm 16.57 \mu\text{m}$, which was reduced to $21.70 \pm 18.55 \mu\text{m}$ of the purified sulphur as given in [Table 3].

Table 3: Particle size of Sulphur in microns (μm) at various stages

	Control	Stage 1	Stage 2	Stage 3
Mean \pm SD	26.12 ± 16.57	25.02 ± 16.39	22.76 ± 19.43	21.70 ± 18.55

Organoleptic characteristics of ghee used at each stage are as follows: Rupa (color) was changed from white to yellow, Rasa (taste) was changed to strong bitter, Gandha (odor) changed from characteristic ghee odor to typical pungent smell of Sulphur and sparsha (consistency/texture) was oily as it is given in [Table 4]

Table 4: Organoleptic Characteristic of ghee at various stages

	Control	Stage 1	Stage 2	Stage 3
Colour	White	Whitish yellow	Milky yellow	Yellow
Odour	Original	Slight sulphur	Sulphur odour	Typical pungent smell of sulphur
Taste	Original	Slight bitter	Slightly bitterness deepened	Bitterness deepened
Touch	Snigdha (oily)	Snigdha (oily)	Snigdha (oily)	Snigdha (oily)

On flame test initially ghee showed yellow red flame which was turn to violet blue at end of purification procedure. Specific gravity was decreased from 1.002 to 0.9387 as given in [Table 5]

Table 5: Physical properties of ghee at various stages

	Control	Stage 1	Stage 2	Stage 3
Flame taste	Yellow red	Slightly blue	Reddish yellow	Violet blue
Loss on drying at 110°C	0.029 %	0.32 %	0.25 %	0.20 %
Refractive index \pm SD	1.46 ± 0.001	1.46 ± 0.008	1.46 ± 0.008	1.46 ± 0.008
Specific gravity	1.012	0.92	0.91	0.94
Ash value	Nil	Nil	Nil	Nil

Saponification value of ghee was 566.61 initially which was decreased to 751.74 at the end of stage 3. But acid value increased from 1.2 to 4.06 which is summarized in [Table 6]

Table 6: Physico- chemical properties of ghee at various stages

	Control	Stage 1	Stage 2	Stage 3
Saponification value	566.61	678.88	760.15	764.24
Acid value	1.2	2.8	2.56	4.06

DISCUSSION

It is clear that Organoleptic characters of sulphur changes considerably after purification process. The colour of purified sulphur becomes reddish. The colour changes at end of each stage. Raw sulphur possesses typical pungent smell but it reduces considerable at end of each stage. End of procedure sulphur almost loses its pungent smell. Similarly taste of raw sulphur which is slightly bitter reduces at each stage and ghee taste increases at different stages of sulphur purification, raw sulphur burns with blue flame. Samples of sulphur at the different stages shown; blue, blue-reddish, violet and blue-violet colors of flame respectively. The change in colour is possible due to entry of ghee particles in sulphur during purification process. Any chemical when subjected to various processes may undergo changes in physical as well as chemical properties. In present study heating and cooling process of sulphur has changed various physical and chemical properties of raw sulphur. The melting point of raw sulphur was 118°C, it decreases at stage 1st and 2nd and leveled up with control at 3rd stage of purification process. Slight decrease in melting point of stages 1 and 2 samples could be due to adhere particle of ghee and milk, which may act as impurities with respect to melting point. The raw sulphur which was brittle in nature changed to hard during the different stages of purification process. The raw sulphur can be easily powdered where as samples of stage 1 and 2 could not be powdered easily. The hardness could be due to combine effect of heating and mixing with ghee and milk, especially with ghee which is fatty in nature. The raw sulphur when dried at 110°C could be losing weight up to 9.43 %. In different stages samples such loss was gradually increases from 9.45 to 9.52 % which may have been resulted due to soaking of milk and ghee in raw sulphur. The milk being the fluid contains ample amount of water and during purification sulphur could have absorbed moisture which when dried get evaporated and resulted in weight loss. The ash value is an indicator of inorganic content in any substance. The raw sulphur being inflammable burns completely leaving behind no ash. Similar was the case with sulphur samples obtained at different stages of sulphur purification. During purification procedure, liquid that used was organic in nature. Although some of ghee particles might have adheres to sulphur particles during heating, organic substances contain in ghee particles and sulphur itself burnt completely to yield no ash. Sulphur is insoluble in water and sparingly soluble in alcohol. Sulphur is completely soluble in carbon tetra sulphide. In the present study raw sulphur sample has solubility in CS₄ about 97 %, which was decrease gradually in each step i.e. 27 %, 25.89 % and 24.1 %. As it is evident from the change in consistency that sulphur become hard and hard at each stage. In order to get more insight in the purification (Shodhana) process of particle size of sulphur are exhibited in Table 3. The mean particle size of raw sulphur was 26 micrometer. As purification continues, sulphur particles become finer and ultimately at last stage particle size of pure sulphur become 21.7 micrometer. The decreases in particle size in all 3 stages were 15 %, 22 % and 26 % consecutively. In order to get more insight into the purification process the study were plan to investigate the changes occurring in ghee used at different stages of purification. The ghee samples were compared with control ghee sample and were assessed for different physical and chemical properties underwent a specific change in purification process. The changes in organo-leptic characters

of ghee are indicated in Table 4. The original white colour of pure ghee changes the whitish yellow colour. These changes in colour could be due to residue of sulphur remaining in ghee samples. This is clearly evident from the colour of third stage sample which is yellow in colour. Similar changes are found in odor, taste and flame. The original odor of pure ghee changes to pungent and taste also changes to bitter. Furthermore the pure ghee burns with yellowish-red flame which at end of process burns with violet blue. The % loss of weight of pure sulphur when dried at 110°C was 0.03 %. After purification significant increase in weight loss at 110°C was found. Loss in weight at stage 1, 2 and 3 was about 28 %, 22 % and 14 % respectively. The refractive index of pure and different stage sample of ghee did not undergo a noticeable change. In control ghee it was 1.46 which was same i.e. 1.46 in 3rd stage sample. So there was no effect of purification process on light deflective properties of pure ghee. The specific gravity of pure ghee was 1.012. It was decrease to 0.92, 0.91 and 0.94 at 1st, 2nd and 3rd stage respectively which is quite significant. The acid value is an indication of free fatty acids present in one gram of oil or fat. The acid values of ghee samples also underwent significant during purification process. The acid value of pure ghee is 1.2 which was increases to 2.8, 2.56 and 4.06 at 1st, 2nd and 3rd stage respectively. The increased acid value indicates a higher tendency towards rancidity. During purification process some of the fatty acids could have been liberated from natural fats.

CONCLUSION

The Shodhana (purification) is process of purification of any medically active substance. This process is carried out in order to remove chemical impurities as well as increase the respective effectiveness. Sulphur one of the important substance is purified by different process. In order to note the changes that occur during Shodhana (purification) process in physical and chemical properties, different samples of various Shodhana stages were collected and investigated. As compared to physical properties purified sulphur exhibit different chemical character. Similar changes were also noted in ghee samples. Present study indicates changes in physical and chemical properties of sulphur only. It was observed that as chemical impurities get removed, therapeutic activities of sulphur increases. In order to investigate fully purification process, those changes in physical and chemical properties of sulphur should be correlated with therapeutic effectiveness by performing clinical trial. Present study will form base for further such investigation in future.

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