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COMPARATIVE PHARMACEUTICAL AND ANALYTICAL EVALUATION OF JARITA VANGA PREPARED BY TWO JARANA METHODS USING APAMARGA CHURNA AND APAMARGA CHURNA WITH KUKKUTANDA TVAK

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ABSTRACT

Background: *Vanga* (Tin) is one of the *Puti Loha* described in *Dhatuprakaran* of *Rasashastra* literature. *Jarana* is the unique pharmaceutical procedure involved in the preparation of *putilouha bhasma*. *Vanga bhasma* after purification subjected to *jarana* with numorous drugs to reduce in small size. Various drugs used for the *jarana* of *vanga* like *apamarga choorna, vata tvaka choorna, kukkutandatvaka,muktashukti raja*. Although *Apamarga Churna* is a classical medium for *Jarana*, the addition of *Kukkutanda Tvak* has been practiced traditionally with the expectation of enhancing oxidation, powder formation and therapeutic effect. **Aim:** To compare the pharmaceutical process and analytical characteristics of *Jarita Vanga* prepared by *Jarana* using *Apamarga Churna* alone and *Apamarga Churna* combined with *Kukkutanda Tvak.* **Materials and Methods**: Raw *Vanga* was subjected to *Samanya Shodhana* followed by *Vishesha Shodhana*. The purified *Vanga* was divided into two batches. Batch I (JVA) underwent *Jarana* with *Apamarga Churna*, while Batch II(JVAK) underwent *Jarana* with *Apamarga Churna* and *Kukkutanda Tvak*. The final products were evaluated using X-ray Fluorescence (XRF) and X-ray Diffraction (XRD). **Results:** XRF analysis revealed tin as the predominant element in both samples, while calcium was significantly higher in the *Kukkutanda Tvak*-treated sample.

XRD analysis identified calcium tin oxide as the major crystalline phase in both preparations, with additional calcium-bearing phases in Batch II. **Conclusion:** Both methods effectively converted metallic *Vanga* into oxidized mineral phases suitable for further processing. The incorporation of *Kukkutanda Tvak* enhanced calcium incorporation and altered the crystalline profile, indicating its influence on the *Jarana* process.

KEYWORDS: *Vanga, Jarana, Apamarga Churna, Kukkutanda Tvak*, XRF, XRD.

INTRODUCTION

Rasashastra is a specialized branch of Ayurveda that deals with the pharmaceutical processing of metals, minerals, and other inorganic substances to transform them into safe and therapeutically effective medicines. Metals in their crude form are considered unsuitable for internal administration because they contain physical and chemical impurities and possess a compact metallic structure that limits biological assimilation. Therefore, classical *Rasashastra* prescribes a sequence of pharmaceutical procedures including *Shodhana*, *Jarana*, and *Marana* before their therapeutic application. These processes are designed to remove impurities, reduce toxicity, increase brittleness, facilitate particle size reduction, and promote conversion into stable mineral structures.

Vanga (Tin) is classified under Puti Loha in classical Ayurvedic literature. It is having *Balya Dipana, Medohara, Vrishya, Madankara* (*Vajikara*) and *Rasayan* properties and therapeutically used in *Prameha, Pandu, Krimiroga, Shukrakshaya, Mutrakrichra, Shwet padara* and other disorders of the genitourinary system.[1] The therapeutic efficacy of *Vanga* depends on proper pharmaceutical processing, as inadequately processed metal may retain undesirable metallic characteristics. Classical texts therefore emphasize that *Vanga* should undergo *Shodhana* before *Jarana* and *Marana*.

Jarana is an intermediate pharmaceutical process between *Shodhana* and *Marana*. The Sanskrit term *Jarana* literally means "roasting." During this procedure, molten purified *Vanga* is continuously stirred with herbal materials until the entire metallic mass loses its lustre and is converted into a fine powder. Classical *Rasashastra* describes *Apamarga Churna* as one of the principal *Jarana* media because its alkaline ash promotes oxidation and facilitates disintegration of molten metal. *Jarana* converts ductile metallic tin into brittle oxide-rich intermediates that can be readily incinerated during Marana. *Kukkutanda Tvak* (hen's eggshell), predominantly composed of calcium carbonate, has traditionally been

incorporated with *Apamarga Churna* by some practitioners during Jarana.[2] At elevated temperatures, calcium carbonate undergoes thermal decomposition to calcium oxide, which may subsequently interact with oxidized tin to form calcium–tin oxide phases. Such reactions may alter the mineralogical composition and physicochemical properties of *Jarita Vanga*.

Modern analytical techniques such as X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) provide valuable information regarding elemental composition and crystalline phase transformation. These techniques help establish scientific evidence supporting the pharmaceutical changes described in classical *Rasashastra*. Therefore, the present study was undertaken to compare *Jarita Vanga* prepared by two Jarana methods using *Apamarga Churna* alone and *Apamarga Churna* with *Kukkutanda Tvak* through pharmaceutical observations and analytical evaluation using XRF and XRD.

AIM

To compare the pharmaceutical process and analytical characteristics of *Jarita Vanga* prepared by two methods of *Jarana* using *Apamarga Churna* alone and *Apamarga Churna* along with *Kukkutanda Tvak.*

OBJECTIVES

To prepare *Shodhita Vanga* according to classical Rasashastra procedures.

To perform *Jarana* using *Apamarga Churna*.

To perform *Jarana* using *Apamarga Churna* and *Kukkutanda Tvak.*

To compare the pharmaceutical observations during Jarana.

To evaluate the prepared *Jarita Vanga* by X-ray Fluorescence (XRF) and X-ray Diffraction (XRD).

To compare the influence of *Kukkutanda Tvak* on the physicochemical characteristics of *Jarita Vanga*.

MATERIALS AND METHODS

a) Samanya Shodhana of *Vanga*[3]

Raw Vanga was melted in an iron pan over mild to moderate heat. The molten metal was immediately poured into *Tila Taila*. After solidification, the metal was removed, cleaned and again melted. The same process was repeated seven times. Each time fresh taila was used. Subsequently, seven *Nirvapana* were performed successively in *Takra*, *Gomutra*, *Kanji* and *Kulattha Kwatha.*

b) *Vishesha Shodhana* of *Vanga*[4]

Fresh *Nirgundi* leaves were collected and *Swarasa* was prepared. 1/16th *Haridra Churna* was mixed thoroughly with the *Swarasa*. The *Samanya Shodhita Vanga* was melted in an iron vessel. The molten *Vanga* was poured into the mixture of *Nirgundi Swarasa* and *Haridra Churna*. After cooling, the *Vanga* was collected and same procedure was repeated thrice.

c) *Jarana of Vanga*[5]

After completion of *Vishesha Shodhana*, the purified *Vanga* was divided into two equal batches.

i) Method I (JVA)-Jarana using one fourth quantity of *Apamarga Churna Shodhita Vanga* was melted in an iron pan. *Apamarga Churna* was added frequently in small quantities. Continuous stirring and rubbing was maintained using an iron ladle. Heating was continued till complete powder was formed. The powder was heaped centrally in pan, covered with earthen saucer and heated strongly till the whole powder becomes red hot. After self -cooling powder was collected, washed several times with distil water and sun dried powder was stored as Jarita Vanga (JVA)

ii) Method II (JVAK)-Jarana using ¼ th quantity of *Apamarga Churna and* ¼ th quantity of *Kukkutanda tvak Shodhita Vanga* was melted in an iron pan. *Apamarga Churna* and *Kukkutanda tvak* was added gradually in small quantities. Continuous stirring and rubbing was maintained using an iron ladle. Heating was continued till complete powder formation occurred. The obtained powder was collected in the centre of pan, covered with earthen saucer and heated intensely till the whole powder becomes red hot. After self-cooling powder was collected, washed several times with distil water and sundried powder was stored as *Jarita Vanga* (JVAK)

d)Analytical Evaluation[6]

The prepared *Jarita Vanga* samples were analyzed using modern analytical techniques.

i)X-ray Fluorescence (XRF)

XRF analysis was performed for determination of elemental composition in *Samanya shodhit Vanga, Vishesh shodhit Vanga* and two samples of *Jarit Vanga*. The technique provides quantitative estimation of major and trace elements without destruction of the sample. The analysis particularly focused on Tin (Sn), Calcium (Ca), Magnesium (Mg)Trace elements.

The results obtained from XRF were compared between both *Jarana* methods to understand the effect of *Kukkutanda Tvak*.

ii)X-ray Diffraction (XRD)

XRD analysis was performed to identify crystalline phases formed during *Jarana*. The powdered samples were scanned over an appropriate 2θ range. Diffraction peaks were matched with standard database. Special attention was given to identification of Tin oxide phases, Calcium tin oxide, Calcium-bearing crystalline compounds, Other mineral phases formed during *Jarana*.

OBSERVATION AND RESULT

Pharmaceutical observations were recorded during shodhana and Jarana are enlisted in table no. 1 and 2. Analytical results of XRF and XRD were shown in chart no. 1, Graph no.1 &2 and Table No.3 and 4.

Table 1: Pharmaceutical Observations during *Samanya* and *Vishesh Shodhana.*

Liquid media Used	Initial Weight of *Vanga*	Final Weight of *Vanga*	Amount of media required for one cycle	Observations Noted
Tila Taila	900gm	906gm	1 lit	Shining white
Takra	906gm	898gm	1.5 lit	Shiny, Brittle
Gomutra	898gm	895gm	1.5 lit	Dull, brittle, some powder form
Kanji	895gm	878gm	1.5 lit	Bright white, more brittle
Kulattha Kwath	878gm	864gm	1.5 lit	Luster reduced, some blackish power form, brittle
Nirgundi patra swarasa+ Haridra	800gm	795gm	1.5 lit	Dull Yellowish gray, Reduced luster, Brittle

Table 2: Comparative pharmaceutical observations during *Jarana.*

Observations	Method I (JVA)	Method II (JVAK)
Weight of *Shuddha Vanga*	300gms	300gms
Weight of *Apamarga Panchang*	75gms	75gms
Weight of *Kukkutanda tvak churna*	-	75gms
Weight of *Jarit Vanga*	320gms	382gms
Colour of molten *Vanga*	Silvery white	Silvery white
Initial reaction	Moderate fuming	Vigorous fuming
Metallic lustre	Completely disappeared	Completely disappeared

Final colour	Grayish white colour	Dull white colour
Texture	Fine Powder	Finer and more friable powder
Metallic particles	Absent	Absent
Ease of powdering	Good	Excellent

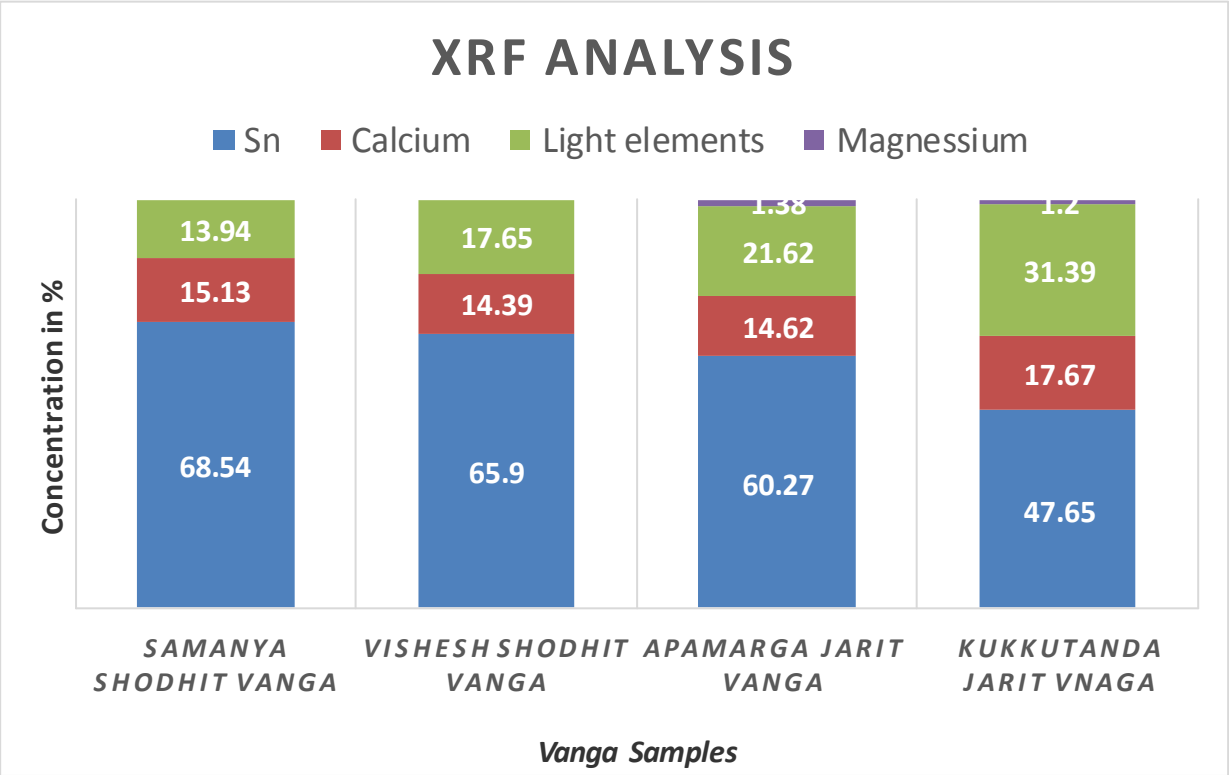
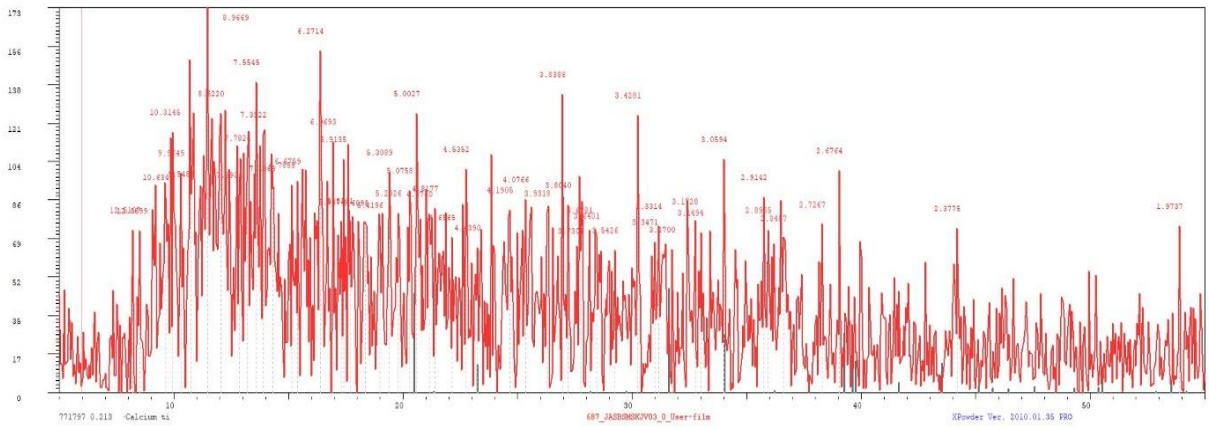


Chart 1:X-Ray Fluorescence (XRF) analysis result of *Shodhit Vanga* and both samples of *Jarit Vanga.*

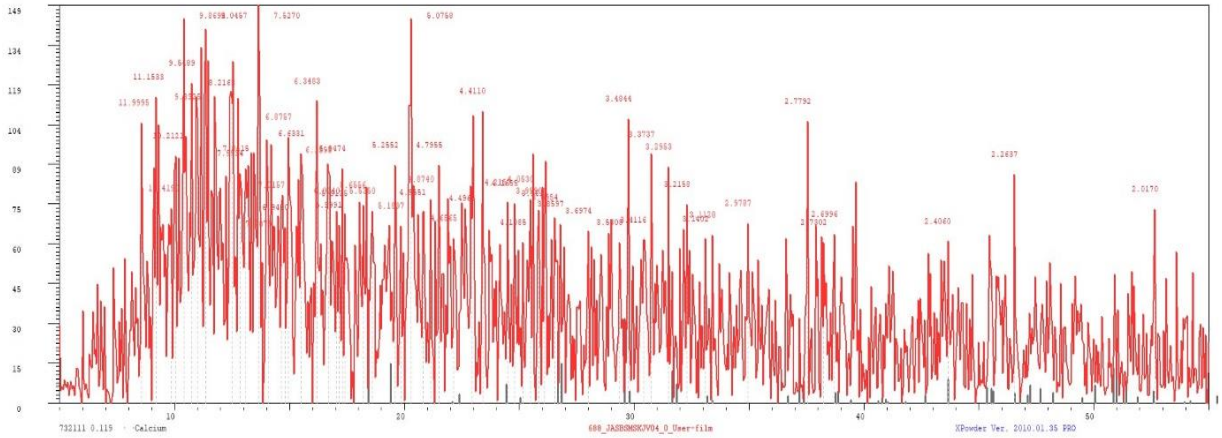


Graph 1: XRD result of JVA Sample.

Table No 3: XRD Analysis report of JVA Sample.

Compound	Composition	Crystal Shape
Malayaite -Calcium tin (IV) oxide silicate	Ca Sn O	Monoclinic

·Calcium Tin Oxide Silicate	(Si O4)	
Calcium tin (IV) oxide ·Calcium Tin Oxide	Ca Sn O3	Orthorhombic



Graph 2: Shows XRD result of JVAK Sample.

Table No 4: XRD Analysis report of JVAK Sample.

Compound	Composition	Crystal Shape
Calcium Tin	Ca2 Sn	Orthorhombic
Calcium tin (IV) oxide ·Calcium Tin Oxide	Ca Sn O3	Trigonal
Calcium Silicate Hydroxide	Ca2 H2 O5 Si	Orthorhombic

DISCUSSION

Shodhana is regarded as the most important pharmaceutical process in *Rasashastra* because it removes physical and chemical impurities while rendering metals suitable for therapeutic use. During *Samanya Shodhana*, repeated *Nirvapa* in *Tila Taila*, *Takra*, *Gomutra*, *Kanji* and *Kulattha Kwatha* produced repeated cycles of heating and rapid cooling. These thermal cycles generated internal stresses within the metal, increasing brittleness and reducing particle cohesion. Simultaneously, the acidic and alkaline media helped remove surface contaminants and oxide layers, thereby improving the pharmaceutical quality of *Vanga*.

Vishesha Shodhana using *Nirgundi Patra Swarasa* and *Haridra Churna* further modified the surface characteristics of *Vanga*. The phytochemicals present in *Nirgundi* and *Haridra* may facilitate oxidation and improve the interaction of molten metal with the *Jarana* media. Classical *Rasashastra* attributes this process to the removal of subtle impurities (*Sukshma Dosha*) and enhancement of the therapeutic qualities of the metal.

During *Jarana*, continuous heating of molten *Vanga* in the presence of *Apamarga Churna* promoted oxidation of metallic tin. *Apamarga* is rich in alkaline ash containing potassium,

calcium, magnesium and silica. These constituents increase the contact surface between molten metal and atmospheric oxygen, facilitating conversion of metallic tin into oxide-rich intermediates. Continuous stirring also breaks the molten metal into smaller particles, increasing the surface area available for oxidation.

The addition of *Kukkutanda Tvak* significantly influenced the *Jarana* process. Eggshell is composed primarily of calcium carbonate. At the high temperatures used during *Jarana*, calcium carbonate undergoes thermal decomposition to calcium oxide with the release of carbon dioxide. Calcium oxide then reacts with tin oxide formed during oxidation to produce stable calcium stannate ($CaSnO_3$) and related calcium-containing phases. This mechanism explains the higher calcium concentration observed by XRF and the additional calcium-bearing crystalline phases identified by XRD in JVAK sample.

The analytical findings strongly support the pharmaceutical observations. XRF confirmed retention of tin as the principal element while demonstrating increased calcium incorporation in the JVAK Sample. Minor and trace elements were introduced from the herbal media and processing materials.

XRD confirmed complete transformation of metallic tin into crystalline oxide phases and showed no residual metallic tin, indicating successful *Jarana*. The formation of calcium stannate is pharmaceutically significant because these crystalline phases are thermally stable and brittle, thereby facilitating subsequent *Marana*. Increased brittleness also contributes to finer particle formation, which is desirable for preparing *Vanga Bhasma* with enhanced bioavailability.

Overall, the present study demonstrates that incorporation of *Kukkutanda Tvak* modifies the mineralogical composition of *Jarita Vanga* and promotes the formation of calcium-rich crystalline phases without compromising the primary tin content. These findings scientifically validate the traditional practice of using *Kukkutanda Tvak* as an adjunct during *Jarana*.

CONCLUSION

The present comparative pharmaceutical and analytical study demonstrates that both *Apamarga Churna* and *Apamarga Churna* with *Kukkutanda Tvak* are effective media for the *Jarana* of *Vanga* after proper *Samanya* and *Vishesha Shodhana*.

Both methods successfully converted metallic *Vanga* into non-metallic oxide-rich powder, as evidenced by the absence of metallic tin peaks in XRD and the predominance of tin-containing mineral phases. XRF analysis confirmed tin as the major element in both samples, while the *Kukkutanda Tvak*-treated sample exhibited significantly greater calcium incorporation. The XRD findings further revealed enhanced formation of calcium–tin crystalline phases in this group.

From a pharmaceutical perspective, the addition of *Kukkutanda Tvak* resulted in faster powder formation, increased brittleness and a finer end product, suggesting that it facilitates the *Jarana* process. Further *Kukkututanda tvak may* help to increase *shukrajanana* effect of vanga bhasm by adding more therapeutic value to it whereas Preclinical or clinical research required to prove these facts. These findings support the classical principles of *Rasashastra* while providing modern scientific evidence for the role of *Kukkutanda Tvak* in modifying the physicochemical characteristics of *Jarita Vanga*.

The combined use of traditional pharmaceutical procedures and advanced analytical techniques such as XRF and XRD establishes a scientific basis for standardization and quality assessment of *Jarita Vanga* before *Marana*.

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