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Development of standard manufacturing process of *Tryushanadya Lauha* – An organo-metalic preparation

Research Article

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Abstract

Tryushanadya Lauha (TL) is one of the herbo-mineral formulations in many Ayurvedic texts. *Tryushanadya Lauha* consists *Loha Bhasma* and *Tryushana*, which includes *Pippali* (*Piper longum* Linn), *Maricha* (*Piper nigrum* Linn), and *Shunti* (*Zingiber officinale* Roscoe), *Cavya* (*Piper chaba* Hunter), *Citraka* (*Plumbago zeylanica* Linn), *Bakuchi* (*Psoralea Corylifolia* Linn), and *Lavana* (salt), which includes *Saindhava* (Sodium chloride), *Aubhida* (sodium carbonate), *Vida* (Ammonium chloride), and *Sauvarchala* (Sodium sulphate). This study is an effort to develop the standard operating process for manufacturing of *Loha Bhasma* and *Tryushanadya Lauha*. As per the reference of Rasatarangini, *Loha Bhasma* (incinerated ash of iron) was prepared in three batches. The processing of *Loha Bhasma* (ash of iron) was performed by adopting, *Shodhana* (purification), a special heating process and *Marana* (incineration). For the process of Levigation decoction of *Triphala* was used. *Puta* (heating process) was given in Electric Muffle Furnace at a temperature of 500 ^{0}C. The percentage of loss was 49.9% after purification. During *Loha Bhasma* (incinerated ash of iron) preparation 14.7%loss and 85.3% gain were observed. This *Loha Bhasma* was used for the preparation of TL. During TL preparation, 0.6% loss was observed & 99.3% was obtained. This study will give the direction for the standard manufacturing process of *Loha Bhasma* (incinerated ash of iron) and *Tryushanadya Lauha.*

Keywords: *Loha*, *Shodhana*, *Marana*, *Triphala Kwatha*, *Bhasma*, *Tryushanadya Lauha*.

Introduction

One of the old but still active health traditions is Ayurveda (1). Under Ayurveda Rasashatra and Bhaishajya Kalpana is a branch, that deals with making pharmaceutical medicines from materials of plants, animals and metallic origin. For a very long time, the Indian system of medicine has used herbal remedies often without any known negative effects (2). The distinctive compound herbo-mineral preparations known as *Lauha Kalpa* use *Loha* as a key component. *Lauha Bhasma* ((incinerated ash of iron) is the main component of *Lauha Kalpa*, which also contains other herbal components due to different processing done while preparation (3). One of the popular herbo-mineral remedies used in Ayurveda to cure diabetes and obesity is *Tryushanadya Lauha* (TL). TL is mentioned in different texts, including Bhaishajya Ratna Vali, Yogaratnakara, Rasachadamshu, and Rasendra Sara Sangraha. For this study reference was taken from Bhaishajya Ratnavali. It contains *Tryushana*, which includes *Pippali* (*Piper longum* Linn), *Maricha* (*Piper nigrum* Linn), *Shunti* (*Zingiber officinale* Roscoe), *Cavya* (*Piper chaba* Hunter), *Bakuchi* (*Psoralea Corylifolia* Linn), *Citraka* (*Plumbago zeylanica* Linn) and *Lavana* (salt), which includes *Saindhava* (sodium chloride), *Aubhida* (sodium carbonate), *Vida* (Ammonium chloride) and *Sauvarchala* (Sodium sulphate). The quantity mentioned was 11 parts of *Loha bhasma* (incinerated ash) and one part of each of the components (4). In the Ayurvedic literature, *Loha* (Iron) is frequently used to treat a variety of illnesses, including Anaemia, Oedema, Jaundice, etc. Before being utilised as medicine, metal passes through several processes including *Shodhana* (Purification), and *Marana* (Incineration) (5). After Purification, the incineration process, which fully alters the physical structure of the raw metal, is completed. Through Marana, the inorganic metal transforms into a readily absorbed biological form which is in a very thin powder form (6). Purification, followed by three types of Iron heating process viz. *Bhanupaka* (Iron heating process under sunlight), *Sthalipaka* (Iron heating process in iron vessel/plate) and *Putapaka* (methodical way of heat application) can be utilised to convert *Loha* (Iron) to *Bhasma* (incinerated ash). Among the three *paka* of *Loha* i.e. last *paka Putapaka* is come under *Marana*

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(incineration) process. They were designed to convert hazardous substances into non-toxic and more potent disease-eradication drugs (7).

In this study, *Tikshna Loha* a type of Iron was used. Different ways of Iron processing were explained by various Authors. For this study, the preparation of *Loha bhasma* (incinerated ash of Iron) was referred from Rasa Tarangini. The Purification treatment not only removes physical and chemical impurities but also strengthens them by incorporating beneficial ingredients. Ayurvedic *Shodhana* (Purification) treatment is the merging of organic substances (herbs or medications derived from animals) into inorganic substances. This addition not only aids in speedier absorption into body fluids but also qualifies it for the subsequent processes of incineration. This makes the metals/minerals brittle, reduces particle size and thus exposes the maximum drug to the purifying medium (8). The Purification of Iron was done by the *Nirvapa* (Quenching) process in a decoction of *Triphala*. Three types of *Loha* processing are *Bhanupaka* (Iron-process in sunlight) and *Sthalipaka* (Iron heating process in iron vessel/plate) and *Putapaka* (methodical way of heat application) by adding a decoction of *Triphala* and process accordingly.

Incinerated ash of Iron was prepared in three batches. The *Bhavana* is a Levigation method that uses organic liquid media. Levigation is a pharmaceutical process which alters physical and chemical changes. Utilizing that elimination of pharmacological side effects can be obtained and medicinal action will be increased. For Levigation also, the decoction of *Triphala* was used. Levigation was done till softness was attained. From the bolus, pellets were prepared, dried in sunlight and kept in crucibles (9). In Rasendra Sara Sangraha it is believed that a methodical way of heat application aids in the removal of impurities while also improving/promoting the characteristics and aiding in the reduction of the specific material, hence it is recommended to use a methodical way of heat application. Further, in connection with Iron, it is stated that the pharmacological efficacy of the material will be directly related to the number of heat cycles received, and the number of heat cycles will help in improving the characteristics by thousands of folds. Only after being treated to the methodical way of heat application can the materials be employed in Mercurials preparations (10). When incinerated ash of iron is produced properly, it increases the strength of the medication and is devoid of hazardous substances. It exhibits enhanced compatibility and promotes effortless assimilation when employed in combination with *Tryushanadya Lauha* (TL). This synergic formulation not only allows for a reduction in dosage but also ensures a potent therapeutic action, optimizing the overall effectiveness of treatment (11).

Aims and objectives

- To prepare *Loha Bhasma* and *Tryushanadya Lauha.*

Materials and Methods

Shodhana (Purification)

It is one of the processes such as heating and dipping, Trituration etc. carried out over a medicinal drug where changes in both physical and chemical. It helps to remove unwanted parts of the drug, control/ eradicate toxic ingredients, potentiate the drug, and to regulate the action of the drug. The purification treatments were meant to reduce the toxicity level to a body-sustainable limit and to make it suitable for further treatment like Incineration (12).

Raw Materials

Loha (Iron) was used in this study and was procured from Dattatraya Ayurved Rasashala, (MGACH & RC). The herbs required for the study were collected from a medicinal plant garden (MGACH & RC). The dry herbs were procured from Dattatraya Ayurved Rasashala and authenticated by the Department of Dravyaguna, MGACHRC. *Loha* was procured from the vendor and authenticated by the Department of Rasashastra & Bhaishajya Kalpana (MGACH & RC).

Pharmaceutical processing

- For the preparation of *Loha bhasma* (incinerated ash of Iron), three batches were prepared namely Batch A, B and C. 300g *Loha* (Iron) for each batch was taken.
- For the manufacture of *Triphala* decoction, different quantities of *Triphala*, how much water should be added, and how long it should be reduced were specified in each *Loha* method.

A) *Shodhana* (Purification) of *Loha*

• Equipment

Gas burner, Steel vessel, Iron vessel, Spatula, Measuring jar, Weighing machine.

• Ingredients

Asuddha Loha (Raw Iron) Batch A-300g, Batch B-300g Batch C-300g, the Decoction of *Triphala* -1400ml (for each batch).

•Procedure

Preparation *Triphala kwatha*

1 part *Triphala* (*Emblica officinalis* Geartn, *Terminalia chebula* Retz, *Terminalia bellirica* Roxb) coarse powder was taken and 8 parts of water were added and reduced to 1/4th, i.e. 2000g of *Triphala* coarse powder taken in vessel and 16000ml of water added. Heated and was reduced to 4000ml. Filtered through a clean cloth and thus obtained decoction of *Triphala*.

Asuddha Loha (Raw Iron) was taken in an iron vessel and heated till red hot and dipped in the decoction of *Triphala*. This process is known as quenching. This quenching process was repeated 7 times and every time fresh media was used.

After Purification, specific purification was adopted includes (*Bhanupaka*, *Sthalipaka* and *Putapaka*) as per reference of Rasatarangini and Rasendra Sara Sangraha.

B) *Bhanupaka* (Iron heating process under sunlight)

Purified *Loha* (Iron) was mixed with a decoction of *Triphala* and exposed to sunlight until it dries.

• Equipment

Iron vessel, Spatula, Measuring jar, and Weighing machine.

• Ingredients

Purified *Loha* -Batch A: 293g, Batch B: 292g, Batch C: 290g, Decoction of *Triphala*-1400ml (for each batch)

• Procedure

Preparation *Triphala kwatha*

Triphala (*Emblica officinalis* Geartn, *Terminalia chebula* Retz, *Terminalia bellirica* Roxb) coarse powder is taken 1 part to this double part of the water was added and reduced to 1/4th, i.e. 1000g of *Triphala* coarse powder taken in a vessel and 2000ml of water added. Boiled it on mild heat and reduced it to 600ml. Filtered it through a clean cloth and thus obtained decoction of *Triphala*.

Shodita Loha (Purified Iron) was taken in a tray and decoction of *Triphala* was added and exposed to sunlight till it dried. The time taken to dry was 3 days. This procedure was repeated 7 times and by using fresh liquid media every time. *Triphala kwatha* every time was prepared in the same proportion as mentioned.

C) *Sthalipaka* (Iron heating process in iron vessel/plate**)**

• Equipment

Iron vessel, Spatula, Measuring jar, and Weighing machine.

• Ingredients

Whatever the obtained each batch was taken for the *Sthalipaka* (Iron heating process in iron vessel/plate) processing – Batch A: 993g, Batch B: 990g, Batch C: 988g, Decoction of *Triphala* -1400ml (for each batch)

• Procedure

Preparation *Triphala Kwatha*

Triphala (*Emblica officinalis* Geartn, *Terminalia chebula* Retz, *Terminalia bellirica* Roxb) coarse powder is taken 1 part and 16 parts of water was added and reduced to 1/8th .250g of *Triphala* coarse powder was taken in the vessel and 4000ml of water was added. Boiled it on mild heat and reduced it to 600ml.Filtered it through a clean cloth to obtain decoction of *Triphala*. Whatever the obtained from *Bhanupaka* (Iron heating process under sunlight) each batch was taken in a vessel and freshly prepared decoction of *Triphala* was added and intense heat was given till complete evaporation of water contents. This process required 4 hours to complete the drying of the decoction of *Triphala*. This process was repeated 7 times.

Washing of *Loha* (Iron)

Whatever Iron was obtained from each batch was taken for washing. It was taken in a vessel and water was added and allowed to settle down. Then the supernatant liquid was removed and the remaining water was removed by heating it till the water evaporated. Then Iron was weight and made into a fine powder and sieved through cotton cloth (13).

D) *Putapaka* (Methodical way of heat application)

• Ingredients

Whatever the obtained each batch was taken for the *Putapaka* processing A: 1550g, B:1539g, C:1534g, cooked Rice: *Suddha Gandhaka* (Purified Sulphur):1883g, *Kumari Swarasa* (Juice of Aloe vera): 4800ml.

• Equipment

Mortar and Pestle, spoon, plate, Measuring jar, Weighing machine, Horizontal Electric Muffle Furnace (EMF).

• Procedure

Gandhaka Shodhana (Purification of Sulphur)

Gandhaka (Sulphur) was purchased from a vendor and identified and authenticated by Rasashastra & Bhaishajya Kalpana, Department of MGAC&RC Salod(H), Wardha.

Equipment

Vessel, Iron vessel, Spoon, Cotton cloth.

Ingredient

Asuddha Gandhaka (Raw Sulphur)-2000g, Ghee-20ml and decoction of *Triphala* -20L.

Procedure

The Iron vessel was taken and ghee was smeared and raw Sulphur was put in the vessel. Continuously stirred till the Sulphur melted. A vessel was taken filled with a decoction of *Triphala* and cotton cloth was covered on it. Then the melted Sulphur was allowed to pass the filtered cotton cloth dip in *Triphala kwatha* (decoction of three fruits). This process was continued 7 times to obtain *Suddha Gandhaka* (purified Sulphur) was obtained. Each time fresh decoction of *Triphala* was used (14).

Preparation of Cooked Rice

- **Ingredients:** Rice: 200g and water 800ml.
- **Equipment**: Vessel, Spoon, Measuring Jar.
- **Procedure:** Control rice was taken in the vessel and washed with water. The mentioned quantity of water was added and boiled until the rice was cooked.

***Putapaka* procedure**

1st *Puta*

Triphala kwatha

Triphala (*Emblica officinalis* Geartn, *Terminalia chebula* Retz, *Terminalia bellirica* Roxb) coarse powder was taken equal to *Loha* (Iron) and 4 parts of water and reduced to 1/4th i.e. 1050g of *Triphala* coarse powder was taken and 6200ml water was added and reduced to 1550ml. *Bhavana* (Levigation) was given with the decoction of *Triphala* till they reached the sign to stop the procedure. Purified Iron was taken in mortar and pestle then decoction of *Triphala* was added and triturated till the paste become smooth and able to prepare the pellet without sticking to the hand and with no cracks. The time required for this was 8 hrs. Pellets flat, round and thin are prepared and dried in the sunlight. Cracks appeared in the pellets after drying. So the Iron was placed in an iron vessel and hot water was added. Triturated with the pestle in mild heat until the fine paste was achieved. Allow it to dry. Later this Iron was processed with control rice to prevent cracks in the

pellets and rice is sticky which helps in the binding agent. The cooked rice was triturated with purified *Loha* until it formed a uniform mixture. The mixture was formed into large pellets and dried in sunlight (15). After drying, the pellets are weight and placed in a crucible. *Puta* (methodical way of heat application) was given in EMF. The crucible was kept under the EMF and kept at 500^{0}C and maintain for 15 minutes (2hrs 30 minutes). The next day when the crucibles are cooled were taken out. Pellets were gathered, weighed, and ground into fine powder. The organoleptic quality and *Bhasma pariksha* (incinerated test) were then noticed. The method was repeated till *Loha Bhasma* (incinerated ash of Iron) was obtained and from the fifth *Puta* onwards the pellets prepared were thin and small in size as compared to before. Average measurements of Pellets, Diameter: 2cm to 2.3 cm, Thickness: 0.4cm to 0.6cm Weight: 6g to 8g (16).

19th -22nd *Puta*

Levigation was given with *Suddha Gandhaka* (purified Sulphur) equal quantity of *Loha* (Iron) and the liquid media was *Kumari Swarasa* (juice of Aloe vera) triturated till it attained sign to stop the procedure (17). Pellets are prepared and dried in sunlight. The pellets are then kept in crucibles and *Puta* (methodical way of heat application) was given with an Electric Muffle furnace at a temperature of 500^{0}C. After self-cooled the *Loha* (Iron) was taken out and made into a fine powder and *Bhasma Pariksha* (parameters to be passed for internal administration) was performed. *Loha* (Iron) did not pass the *Bhasma Pariksha* so it was further *Puta* (methodical way of heat application) was given. For the 23rd *Puta* levigation was given only with *Kumari Swarasa* (juice of Aloe vera). After the 23rd *Puta*, *Loha* attained *Pakva Jambu phala varna* (colour like that ripened *Syzygium cumini*) and attained parameters to be passed for internal administration.

Table 1: Results obtained during the process of *Shodhana* (Quenching)

	Wt of *Loha*		Wt/Loss after purification	
Batch No.	**Before**	**After**	**Gram (g)**	**Percentage %**
A	300g	294g	6g	2%
B	300g	293g	7g	2.3%
C	300g	291g	9g	3%
Average	300g	292g	7.3 g	2.4%

Table 2: Results obtained during the process of *Bhanupaka Loha*

	Wt of *Loha*		Wt/Gain after purification	
Batch No.	**Before**	**After**	**Gram (g)**	**Percentage %**
A	293g	993g	700g	238.9%
B	292g	990g	698g	239%
C	290g	988g	698g	240.6%
Average	291.6g	990g	698g	239.5%

Table 3: Results obtained during the process of *Sthalipaka Loha*

	Wt of *Loha*		Wt/Gain after purification	
Batch No.	**Before**	**After**	**Gram (g)**	**Percentage %**
A	993g	2099g	1106g	111.3%
B	990g	2094g	1104g	111.5%
C	988g	2084g	1096g	110.9%
Average	990g	2092g	1102g	111.2%

Table 4: Results obtained after washing of *Loha*

	Wt of *Loha*		Wt/Loss after purification	
Batch No.	**Before**	**After**	**Gram (g)**	**Percentage %**
A	2099g	1551g	548g	49.5%
B	2094g	1540g	550g	50.1%
C	2084g	1534g	546g	50.1%
Average	**2092g**	**1541g**	**548g**	**49.9%**

Table 5: Results obtained during the *Loha* incineration procedure

Bhavana / puta	A batch	B batch	C batch	Before *Puta* Weight	After *Puta* Weight	Colour of pellets After heating in EMF	Wt/loss after Heating in EMF	% loss
1	600ml *Loha* -558g	600ml *Loha* -554g	600ml *Loha*-550g	A -569g B-566g C- 5 61 g	A-400g B-398g C-396g	Blackish	169g 168g 165g	30.2% 30.3% 30%
2	500ml *Loha* -399g	500ml *Loha* -397g	500ml *Loha* -395g	A -424g B-420g C- 418 g	A-342g B-338g C-336g	Blackish	57g 59g 59g	14.2% 14.9% 14.9%
3	300ml *Loha* -341g	300ml *Loha* -337g	300ml *Loha* -335g	A -362g B-358g C-356 g	A-312g B-308g C-307g	Blackish	30g 29g 29g	8.7% 8.5% 8.6%
4	300ml *Loha* -311g	300ml *Loha* -307g	300ml *Loha* -306g	A -332g B-329g C-322g	A-302g B-299g C-296g	Blackish	10g 9g 10g	3.2% 2.9% 3.2%
5	300ml *Loha* -301g	300ml *Loha* -298g	300 ml *Loha* -295g	A -321g B-319g C-316g	A-295g B-294g C-290g	Blackish	6g 4g 5g	1.9% 1.3% 1.6%
6	300ml *Loha*-294g	300ml *Loha*-293g	300ml *Loha*-289g	A -314g B-313g C- 308g	A-292g B-290g C-287g	Blackish	2g 3g 2g	0.6% 1% 0.6%
7	300ml *Loha*-291g	300ml *Loha*-289g	300ml *Loha*-286g	A -306g B-304g C- 301g	A-288g B-287g C-284g	Blackish	3g 2g 2g	1% 0.6% 0.6%
8	300ml *Loha*-287g	300ml *Loha*-286g	300ml *Loha*-283g	A -300g B-298g C- 296g	A-285g B-284g C-281g	Blackish	2g 2g 2g	0.6% 0.6% 0.6%
9	300ml *Loha*-284g	300ml *Loha*-283g	300ml *Loha*-280g	A -299g B-297g C- 296g	A-281g B-280g C-278g	Blackish	3g 3g 2g	1% 1% 0.6%
10	300ml *Loha*-280g	300ml *Loha*-279g	300ml *Loha*-278g	A -296g B-294g C- 293g	A-278g B-277g C-276g	Blackish	2g 2g 2g	0.7% 0.7% 0.7%
11	300ml *Loha*-277 g	300ml *Loha*-276g	300ml *Loha*-275g	A -289g B-287g C- 286g	A-259g B-257g C-257g	Blackish	18g 19g 18g	6.4% 6.8% 6.4%
12	300ml *Loha*-258g	300ml *Loha*-256g	300ml *Loha*-256g	A -278g B-276g C- 276 g	A-246g B-246g C-245g	Blackish	13g 10g 10g	5% 3.9% 3.9%
13	300ml *Loha*-245g	300ml *Loha*-245g	300ml *Loha*-244g	A -265g B-265g C-269g	A-230g B-230g C-231g	Blackish	15g 13g 13g	6.1% 5.3% 5.3%
14	300ml *Loha*-244g	300ml *Loha*- 244g	300ml *Loha*-243g	A -264g B-266g C- 263g	A-234g B-235g C-232g	Brownish	10g 9g 11g	4% 3.6% 4.5%
15	300ml *Loha*-233g	300ml *Loha*-234g	300ml *Loha*-231g	A-254g B-255g C- 250g	A-229g B-230g C-228g	Brownish	4g 4g 3g	1.7% 1.7% 1.2%
16	280ml *Loha*-228g	280ml *Loha*-229g	280ml *Loha*-227g	A -240g B-242g C- 240g	A-225g B-226g C-225g	Blackish	3g 3g 2g	1.3% 1.3% 0.8%
17	280ml *Loha*-224g	280ml *Loha*-225g	280ml *Loha*-224g	A -239g B-240g C- 238g	A-221g B-222g C-221g	Blackish	3g 3g 3g	1.3% 1.3% 1.3%
18	280ml *Loha*-220g	280ml *Loha*-221g	280ml *Loha*-220g	A -238g B-239g C- 238g	A-216g B-217g C-215g	Blackish	4g 4g 5g	1.8% 1.8% 2.2%
19	*Su.Gandhaka*-215g Loha-215g *Kumari swarasa*-400ml	*Su.Gandhaka*-216g *Loha*-216g *Kumari swarasa*-400ml	*Su.Gandhaka*-214g *Loha*-214g *Kumari swarasa*-400ml	A -441g B-443g C- 439g	A-211g B-212g C-210g	Reddish brown	4g 4g 4g	1.8% 1.8% 1.8%

20	*Su.Gandhaka*-210g *Loha*-210g *Kumari swarasa*-400ml	*Su.Gandhaka*-211g *Loha*-211g *Kumari swarasa*-400ml	*Su.Gandhaka*-209g *Loha*-209g *Kumari swarasa*-400ml	A -431g B-434g C-429 g	A-205g B-206g C-200g	Reddish	215g 216g 369g	51% 51% 88.8%
21	*Su.Gandhaka*-204g *Loha*-204g *Kumari swarasa*-400ml	*Su.Gandhaka*-205g *Loha*-205g *Kumari swarasa*-400ml	*Su.Gandhaka*-199g *Loha*-199g *Kumari swarasa*-400ml	A -420g B-425g C- 410 g	A-196g B-198g C-189g	Reddish	212 212 209	51% 51% 52.5%
22	Loha-195g *Kumari swarasa*-200ml	Loha-197g *Kumari swarasa*-200ml	Loha-188g *Kumari swarasa*-200ml	A -213g B-218g C- 208 g	A-190g B-194g C-183g	Reddish brown	5g 3g 5g	2.5% 1.5% 2.6%
23	Loha-189g *Kumari swarasa*-200ml	Loha-193g *Kumari swarasa*-200ml	Loha-182g *Kumari swarasa*-200ml	A -204g B-210g C- 200g	A-185g B-190g C-180g	Reddish brown	4g 3g 2g	2.1% 1.5% 1%
Average				553.6g	418g		69.8g	14.7%

Table 6: Classical Organoleptic character of *Loha bhasma*

No.of *Puta*	Colour	Taste	Touch	Odour	Lustre
1st	Blackish	Metallic	Soft	Metallic	Present
2nd	Blackish	Mild Metallic	Soft	Mild Metallic	Present
3rd	Blackish	Tasteless	Soft	Absent	Mild
4th-6th	Blackish	Tasteless	Soft	Absent	Absent
5th	Blackish	Tasteless	Soft	Absent	Absent
6th	Blackish	Tasteless	Soft	Absent	Absent
7th-13th	Blackish grey	Tasteless	Soft	Absent	Absent
14th-17th	Brownish	Tasteless	Soft	Absent	Absent
18th	Blackish	Tasteless	Soft	Absent	Absent
19th	Reddish brown	Sour	Soft	Metallic	Absent
20th	Reddish brown	Sour	Very soft	Present	Absent
21st	Reddish brown	Mild sour	Very soft	Present	Absent
22nd	Reddish brown	Tasteless	Very soft	Absent	Absent
23rd	Reddish brown	Tasteless	Very soft	Absent	Absent

Table no.7 *Bhasma Pariksha* of *Loha* after each *Puta*

No.of *Puta*	*Rekhapurnatva*	*Varitara*	*Nirswadu*	*Mrudutwa*	*Dantagrekachcha Bhava*
1st	-	-	Metallic	+	+++
2nd	-	-	Mild Metallic	+	++
3rd	-	-	Tasteless	+	++
4th	-	-	Tasteless	+	++
5th	-	-	Tasteless	+	+
6th	+	+	Tasteless	+	+
7th	+	+	Tasteless	+	+
8th	+	+	Tasteless	+	+
9th	+	+	Tasteless	+	+
10th	+	+	Tasteless	+	+
11th	+	+	Tasteless	+	+
12th	+	+	Tasteless	+	+
13th	+	+	Tasteless	+	+
14th	++	++	Tasteless	++	+
15th	++	++	Tasteless	++	+
16th	++	++	Tasteless	++	+
17th	++	++	Tasteless	++	+
18th	+	+	Tasteless	+	+
19th	++	++	Sour	++	+
20th	++	++	Sour	++	+
21st	++	++	Mild Sour	++	+
22nd	+++	+++	Tasteless	+++	-
23rd	+++	+++	Tasteless	+++	-

Absent (-), Present (+)

Table 8: Test of *Loha Bhasma*		
Unnama	***Nirdhuma***	***Apurnabhava***
Passed	**Passed**	**Passed**

Preparation of *Tryushanadya Lauha*

Ingredients

Table 9: Show the ingredients, Part and Quantity use for preparation			
Sl.no	**Drugs**	**Part use**	**Quantity**
1	*Pippali* (*Piper longum* Linn)	Fruit	15g
2	*Marica* (*Piper nigrum* Linn)	Fruit	15g
3	*Sunthi* (*Zingiber Officinale* Roscoe)	Fruit	15g
4	*Cavya* (*Piper chaba* Hunter)	Stem	15g
5	*Citraka* (*Plumbago zeylanica* Linn)	Roots	15g
6	*Bakuchi* (*Psoralea Corylifolia* Linn)	Seeds	15g
7	*Vida lavana* (Ammonium chhloride)	-	15g
8	*Saindhava lavana* (Sodium chloride)	-	15g
9	*Aubhidha lavana* (Sodium carbonate)	-	15g
10	*Sauvarchala lavana* (Sodium sulphate)	-	15g
11	*Loha Bhasma* (incinerated ash of Iron)	*Bhasma*	165g
		Total	315g

Instrument: Mortar and Pestle, Spoon, Sieve no 100 mesh, plate.

Method of preparation:

Table 8 shows the ingredients, parts and quantity used for preparation. All the ingredients are made into fine powders separately and sieved through cotton clothes. Fine powders of all ingredients were taken in the vessel in mentioned quantity and mixed thoroughly and continuously mixing till it attained a homogeneous mixture. The mixture was sieved through 100 Mesh. Organoleptic characters were observed and stored in air-tight glass containers to prevent moisture (18).

Table 10: Obtained quantity of *Tryushanadya Lauha*					
Sr. no	**Batches**	**Total quantity of ingredient (g)**	**Obtained quantity (g)**	**Weight loss (g)**	**% Weight loss**
1	A	315g	313g	2g	0.6%
2	B	315g	313g	2g	0.6%
3	C	315g	313g	2g	0.6%
	Average	315g	313g	2g	0.6%

Table 11: Organoleptic character of *Tryushanadya Lauha*				
Sr.no	**Parameter**	**Batch A**	**Batch B**	**Batch C**
1	Colour	Reddish brown	Reddish brown	Reddish brown
2	Odour	Specific smell of *Lavana* (salt) and pungent	Specific smell of *Lavana* (salt) and pungent	Specific smell of *Lavana* (salt) and pungent
3	Taste	*Katu* (Pungent), *Lavana* (salt)	*Katu* (Pungent), *Lavana* (salt)	*Katu* (Pungent), *Lavana* (salt)
4	Touch	Smooth	Smooth	Smooth
5	Appearance	Fine powder	Fine powder	Fine powder

Observation and Results

Loha (Iron) was hard and lustrous in colour, before *Shodhana* (purification), *Bhanupaka* (Iron heating process under sunlight) and *Sthalipaka Loha* (Iron heating process in iron vessel/plate) and after processing *Loha* obtained was blackish in colour and brittle. For processing of *Shodhana* 1400ml of decoction of *Triphala* was required (for each batch). After the *Bhanupaka* (Iron heating process under sunlight) procedure, *Loha* gains weight and becomes more brittle and blackish. During the *Sthalipaka* (Iron heating process in iron vessel/plate) process, the weight of Iron increased continuously due to decoction of *Triphala* residue, and it grew more brittle and royal blue in hue. Obtained quantity of *Loha* after the Purification process was 292g (average of three batches), and the Loss found was 7.3g (average of three batches). The Percentage of Loss on average was 2.4% shown in Table 1. The Loss could be due to material as the Iron becomes small particles during the process. In *Bhanupaka* (Iron heating process under sunlight) and *Sthalipaka* (Iron heating process in iron vessel/plate) increase the weight of Iron is due to the residue of the decoction of *Triphala*. Obtained quantity of Iron after *Bhanupaka* (Iron heating process under sunlight) is 990g (average of three batches), and the gain found was 698g (average of three batches). The Percentage of gain on average was 239.5%.shown in Table 2. Obtained

quantity of Iron after *Sthalipaka* (Iron heating process in iron vessel/plate) is 2092g (average of three batches), and the gain found was 1102g (average of three batches). The Percentage of gain on average was 111.2%.shown in Table 3. Some particles may be lost during the washing process after *Sthalipaka* (Iron heating process in iron vessel/plate). The average loss during washing was 548g. The percentage of loss was 49.9%. The observations are depicted in Table no 4. The metallic sound was present during the Levigation process initially, but it vanished after trituration, hence it took a long time to attain a sign to stop the procedure. Pellets, which are soft, light, and cracked, were made for the first *Puta* (methodical way of heat application) When the pellets dried, there was a split and a fragile break. Hence it was processed with rice and cooked rice was prepared. As rice is sticky and acts as a binding agent, the pellets were made into powder and triturated with cooked rice (19).

The weight was reduced as a result of the methodical way of heat application. Classical *Bhasma* (incinerated ash) characteristics such as *Rekhapurnatva* (powder should penetrate finger lines) and *Varitaratva* (powder should float on water), *Niswadu* (should be tasteless), *Dantagrekach bhava* (when placed in between the teeth while chewing there should not be any particles) were seen (20). In the fifth *Puta*, pellets are small, soft, and heavy. Mild *Rekhapurnatva* (powder should penetrate finger lines) was obtained after the seventh unit of heat when the Iron turned blackish-grey in colour. After the 14th *Puta Loha* turns reddish, moderate *Varitara* (powder should float on water), *Mrudutva* (smoothness), and *Niswadu* (tasteless) are obtained. Iron attained *Varitara* (powder should float on water), *Rekhapurnatva* (powder should penetrate finger lines) *Dantagrekach bhava* (powder should float on water), reddish brown in hue, and sour in taste after the 19th *Puta*. On the 23rd, *Puta Loha* completed all *Bhasma Pariksha* (incinerated test) parameters and attained *Pakva Jambu varna* (colour like that ripened fruit *Syzygium cumini*). Following the incineration procedures, the obtained quantity of 418g and the loss was 69.8g. The percentage of Loss was 14.7% shown in Tables 5 and 7. In Table 6 show Organoleptic character of *Loha bhasma* (incinerated ash) during processing. *Tryushanadya lauha* ingredient and quantity were mentioned in Table 8, the obtained quantity of 313g and the loss was 2g. The percentage of Loss was 0.6% depicted in Table 9. The loss may occur as a result of particle size reduction. TL organoleptic character is depicted in table no 10.

Discussion

Bhasma (Incinerated ash) is a unique Ayurvedic metallic/minerals preparation, treated with herbal juice or decoction and exposed for Ayurveda, which is known in the Indian subcontinent since the 7th century A.D. and widely recommended for the treatment of a variety of chronic ailments. The end product of incineration is incinerated ash of a substance (21). It finely grinds the coarse powder of the material and prepares it for further incineration processing. It causes unique and appropriate physicochemical changes and offers trace elements for synthesizing incinerated ash (22). To obtain any incinerated ash the metals or minerals have to go through the purification and Incineration processes. Specific three types of Iron heating process viz. *Bhanupaka* (Iron heating process under sunlight), *Sthalipaka* (Iron heating process in iron vessel/plate) and *Putapaka* (methodical way of heat application) of *Loha* (Iron). According to Rasatarangini the process of Purification *Nirvapa* (quenching) methods was used. For *vishesha Shodhana* (specific purification), the Quenching process was adopted by heating *Loha* and dipping in the vessel which contains 600ml decoction of *Triphala*. Each time fresh decoction was taken. During the process, the Iron colour changes to black and becomes brittle. Later the Iron was subjected to the *Bhanupaka* (Iron heating process under sunlight) process where the Iron was soaked in a decoction of *Triphala* approximately 600ml.Then dried in sunlight. It took 3 days for drying. There was an increase in the weight of Iron and becomes more brittle and blackish after the *Bhanupaka* (Iron heating process under sunlight) process. For *Sthalipaka Loha* (The iron heating process in iron vessel/plate) *Bhanupaki loha* was taken and 600ml decoction of *Triphala* was taken in the vessel and heated. Heat till all water contents evaporated so it took 4 hours to complete. For the preparation of decoction of *Bhanupaka* appears that the decoction may not be possible with two times water and reduced to one-quarter as *Triphala* absorb much of the water. Probably the underlying idea in recommending less quantity of water might be because in *Bhanupaka* the concentrated extract of *Triphala* is needed to reduce the iron on coming in contact with atmospheric oxygen in the presence of acidic media and some amount of heat (23). During the *Sthalipaka* (Iron heating process in iron vessel/plate) process, there was a continuous increase in the weight of Iron due to the decoction of *Triphala* residue and became more brittle. This is due to the accumulation of *Triphala* residue. To remove the decoction of *Triphala* residue the Iron was processed with water. So Purification and three types of Iron heating process decoction of *Triphala* were used. Most of the Acharya mentioned *Loha* to process with a decoction of *Triphala* as it consists mainly of ascorbic acid and tannin. With the presence of ascorbic i.e. vitamin C and phenolics help in the absorption of iron from food. Ascorbic acid helps to increase the bioavailability of Iron by converting Fe3+ Fe2+ while tannin can reduce the bioavailability of iron by binding to its phenolics. If there is an excess of ascorbic acid or a lack of tannins in the diet both are suggested as contributing to pathological iron storage diseases. In incinerated ash, Iron formed contains Iron in the form of Ferrous or in oxide form which are considered to be the most compatible forms of iron supplementation in the body. The rate of the absorption of the iron depends on the fineness of the powder. The incinerated ash process makes the metal into very minute particles which are easy to absorb. This may also be interpreted as many *Triphala* constituents working against one another. Thus how too much absorption is prevented

(24). So for the same reason, *Loha* was given *Bhavana* with a decoction of *Triphala*. Levigation is a process which helps in reducing the particle's size. Due to heat produced during grinding. There may be the possibility of a chemical reaction between a material and media and thus chemical reaction changes and the desired compound can be obtained (25). During Levigation initially, the metallic sound was observed and the total duration for soaking the liquid media was of 6hrs.After getting paste form, round, flat and thin pellets were prepared and kept for drying. The uniformity cannot be maintained as they were prepared manually. After the pellets are dried there was a crack and they became fragile (break when touched). So the pellets were processed with cooked rice as rice was sticky and acted as the binding agent. Rice contains amylase, gelatinization temperature and gel consistency (26). So Iron was triturated with the cooked rice till it attains a homogenous mixture. By this pellets were of large sizes could be prepared and are free from cracking after drying. The Pellets thus prepared were soft, light and with minor cracks. Later after the 4th *Puta* the pellets were prepared with round, thin, black and flat for enhance the surface area of the materials to allow maximum heat transfer during the methodical ways of heating process (27). This Loss could be attributed to water evaporation and the combustion of organic or inorganic components. The methodical ways of heating were given in an Electric Muffle furnace at 500^0C maintained for 15min. The Muffle furnace reaches a temperature of 500^0C. Muffle Furnace took 2hr 30 min. EMF is more convenient for establishing standard operating procedures due to the ease of watching and recording temperature.

There were cracks in pellets till the 4th *Puta*. For 5th *Puta*, pellets were small in size, soft, black in colour and heavy. During the process, the loss was observed. There were not many changes observed in Iron till the 6th *Puta*. After the 7th *Puta*, Pellets turn to blackish grey, and mild *Rekhapurnatva* (powder should penetrate finger lines) was attained. After the 14th *Puta* pellets turned to brownish colour, and mild *Varitara* (powder should float on water), *Mrudutva* (smoothness) and *Niswadu* (tasteless) attained.

After the 18th *Puta*, the *varitaratva* was not obtained. Hence, in the 19th *Puta Suddha Gandhaka* was added as an equal quantity of *Loha*. The mixture was triturated by adding the juice of Aloe vera. In Rasarnava it is mentioned that there is no *Loha* on earth which cannot be reduced by sulphur. The metals will get reduced simply because of the odour of sulphur and thus reduced metals directly assimilate into circulation (28) helping in particle size reduction, uniform mixing of iron and potentiating of the product and bringing compactness. It may add some organic and inorganic trace elements into the final compound along with enhancement of therapeutic qualities of the compound (29).

After the 19th *Puta*, Iron attained better *Rekhapurnatva* (powder should penetrate finger lines) and *Varitaratva* (powder should float on water), *Dantagrekach bhava* (when placed in between the teeth while chewing there should not be any particles), reddish brown and had a sour taste. After the 21st *Puta*, all the *Bhasma pariksha* (incinerated test) were attained to some extent but there was odour and sour taste so the Iron was only given Levigation with juice of Aloe vera for all batches. So after the 22nd *Puta*, the *Loha* was observed and the odour and sour taste disappeared. On the 23rd *Puta*, *Loha* achieved all parameters of *Bhasma Pariksha* (test for administration) and attained *Pakva Jambu varna* (colour of *Syzygium cumini* ripen fruit).

Tryushanadya Lauha is mentioned by different Acharya with help in treating various diseases. As *Loha Bhasma* (incinerated ash of Iron) is the main ingredient. It has *Tikta*, *Kashaya rasa* (bitter and astringent taste) and *Sheeta Virya* (hot potency). It possesses *Guru* (heavy), *Ruksha* (dry) and *Lekhana* (scraping) properties which subsides *Meda* (fatty tissue) and *Kapha dosha*. It is *Balya* (improves physical strength), *Vrishya* (Aphrodisiac), *Varnya* (improves complexion), *Medhya* (improves intelligence) and *Rasayana* (Rejuvenate). It pacified *Kapha Pitta dosha*. It cures *Kshaya roga* (Depletion of tissues), *Medoroga* (Fatty tissue disorders) and *Prameha* (Diabetes) etc (30).

Pippali (*Piper longum* Linn) has *Katu rasa* (pungent taste), *Laghu* (light), *Snigdha* (unctuous), *Tikshna* (sharp), *Anusna virya* (not very hot potency), *Dipana* (kindles digestive enzymes), *Rasayana* (Rejuvenate) and *Vrishya* (Aphrodisiac) properties. It pacified *Vata* and *Kapha dosha*. It is beneficial in *Kasa* (Cough), *Swasa* (Respiratory disorders), *Udara roga* (Abdominal disorders), *Prameha* (Diabetes) etc (31).

Maricha (*Piper nigrum* Linn) has *Katu rasa* (pungent taste), *Laghu* (light), *Tikshna* (sharp), *Usna Virya* (hot potency), *Dipana* (kindles digestive enzymes), *Pramathi* (dislodge the adherent *dosha* in minute channels) properties. It pacified *Kapha* and *Vata dosha*. It is beneficial in *Jwara* (fever), *Swasa* (Respiratory disorders), *Hridroga* (Cardiac disorders), *Krimi* (Intestinal worm) etc (32).

Shunti (*Zingiber officinale* Roscoe) has *Katu rasa* (pungent taste), *Guru* (heavy), *Ruksha* (dry), *Tikshna* (sharp), *Usna Virya* (hot potency), *Dipana* (kindles digestive enzymes), *Bhedana* (break the hard mass of stool and push it out). It alleviates *Vata* and *Kapha dosha*. It helps in treating *Jwara* (fever), *Kasa* (Cough), *Swasa* (Respiratory disorders), *Hridroga* (Cardiac disorders) etc (33).

Chavya (*Piper chaba* Hunter) has *Katu rasa* (pungent taste), *Laghu* (light), *Ruksha* (dry), *Usna Virya* (hot potency), *Dipana* (kindles digestive enzymes), *Pacana* (appetizer). It pacified *Vata* and *Kapha dosha*. It is beneficial in *Atisara* (Diarrhoea), *Udara roga* (Abdominal disorders), *Krimi* (Intestinal worm), *Sula* (pain), *Swasa* (Respiratory disorders) etc (34).

Bakuchi (*Psoralia corylifolia* Linn) has *Katu* and *Tikta rasa* (pungent & bitter taste), *Sara* (promote natural movement of body fluids), *Laghu* (light), *Ruksha* (dry), *Usna Virya* (hot potency), *Ruchya* (improve taste), *Hridya* (cardiac tonic). It pacified *Kapha* and *Vata dosha*. It helps in treating *Medoroga* (Fatty tissue disorders), *Swasa* (Respiratory disorders),

Kustha (skin disorders), *Hridroga* (Cardiac disorders), *Jwara* (fever) etc (35).

Chitraka (*Plumbago zeylanica* Linn) *Katu rasa* (pungent taste), *Ruksha* (Dry), *Tikshna* (sharp), *Usna Virya* (hot potency), *Dipana* (kindles digestive enzymes), *Pacana* (appetizer), *Grahi* (absorbent). It pacified *Kapha* and *Vata dosha*. It helps in treating *Udara shoola* (Abdominal disorders), *Arshas* (Haemorrhoids), *Kustha* (Skin disorders), *Krimi* (Intestinal worm) etc (36).

Saindhava Lavana (Sodium chloride) has *Snigdha* (unctuous), *Laghu* (light), *Mrudu Virya* (soft potency), *Hridya* (Cardiac tonic), *Vrishya* (Aphrodisiac), *Dipana* (kindles digestive enzymes), *Pachana* (appetizer), mitigates all three *dosha*. It reduces joints disorder such as rheumatoid arthritis and osteoarthritis.

Sauvarchala Lavana (sodium sulphate) has *Laghu* (light), *Snigdha* (unctuous), *Hridya* (cardia tonic), *Pachana* (appetizer), *Dipana* (kindles digestive enzymes), *Ruchikaraka* (increase appetite), *Urdhva Vata Anulomaka* (bring down the above *Vata* to downward direction). It mitigates *Vata dosha*. It is useful in *Aruci* (Tastelessness), *Vibandha* (Constipation), *Udara sula* (Abdominal pain).

Vida Lavana (Ammonium chloride) has *Kshara rasa* (alkaline taste), *Laghu* (light), *Tikshna* (sharp), *Suksma* (ability to enter the minute channels of the body), *Usna Virya* (hot potency), *Dipana* (kindles digestive enzymes), *Anuloma* (bring the *dosha* in downward direction), *Ruchikaraka* (increase appetite). It mitigates *vata dosha*. It is beneficial in *Ajirna* (indigestion), *Sula* (pain), *Vibanda* (Constipation), and *Hridroga* (Cardiac disorders).

Aubhida Lavana (Sodium carbonate) has *Tikta*, *Katu*, *Kshara rasa* (bitter, pungent and alkaline in taste), *Tikshna* (sharp), *Sukshma* (ability to enter the minute channels of the body), *Usna Virya* (hot potency) and *Vatanulomaka* (ability to bring *Vata* to downward and remove out the body) properties (37).

Lauha Bhasma contains both Fe(II) and Fe(III) oxidation states, making it an obvious biogenic choice for our body to improve iron storage in the ferritin protein in the Fe(III) state, as well as to maintain adequate availability of the Fe(II) state in the bloodstream for better oxygen absorption in the lungs. Thus, *Lauha Bhasma* is projected to perform better in treating anaemia in humans than the commonly utilised ferrous-based compounds in modern allopathy medications (38). Various research groups have studied the therapeutic potential of *Piper longum* Linn for anti-amebic, anthelminthic, anti-cancer, anti-diabetic, hepatoprotective, antimicrobial, and larvicidal properties etc. (39). Numerous investigations on *Piper nigrum* Linn have shown that it has qualities such as anti-diarrheal, digestive, antidepressant, immunomodulatory, anticonvulsant, and analgesic activities etc. (40). Research indicates that *Zingiber officinale* Roscoe contains antimicrobial, hepatoprotective, nephroprotective, antioxidant, digestive, antidiabetic, anti-inflammatory, and analgesic effects (41). *Plumbago zeylanica* Linn has numerous known pharmacological effects, including antibacterial, antifungal, antiinflammatory, antidiabetic, anticancer, antioxidant, hepatoprotective, cytotoxic, and wound healing properties (42). *Piper chaba* Hunter has pharmacological activities such as anticancer, immunomodulatory effect, antimalarial, antituberculosis, cytotoxic activities, antimicrobial, immunomodulatory, hepatoprotective, antioxidant, immunomodulatory effect, antimalarial, antituberculosis, cytotoxic activities, and so on (43). According to the research findings, *Psolarea cordifolia* Linn has pharmacological properties such as antibacterial, pesticidal, hepatoprotective, antioxidant, anti-inflammatory, and anti-tumour action etc. (44). *Lavana* (salt) is a catalyst for digestion. It is hygroscopic and promotes lubrication. *Lavana* softens and improves meal digestion by boosting saliva and gastric juice output. It has both carminative and digestive properties (45).

Conclusion

Pharmaceutical standardization helps in developing standard manufacturing procedures without disturbing the efficacy and safety profile of a drug. The pharmaceutical procedure involved here was *Shodhana* (Purification) i.e. *Nirvapa* (Quenching), three types of the heating process of Iron and preparation of *Tryushanadya Lauha*. The procedure of *Shodhana* (Purification) removes the toxic nature of the *Loha* (Iron) and reduction of compactness. *Marana*'s procedure helps in size reduction and making *Bhasma* (incinerated ash) more bio-available. Such properly prepared incinerated ash ensures a potent therapeutic action, optimizing the overall effectiveness of treatment.

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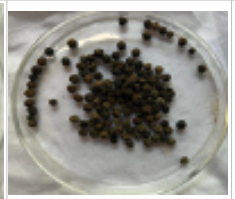
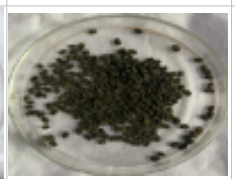
The following images of *Loha* Processing

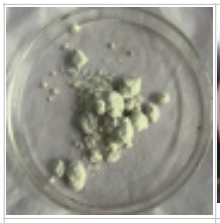
Fig 1: *Raw Loha*	**Fig 2: *Triphala kwatha***	**Fig 3: *Nirvapa* of *Loha* in *Triphala kwatha***
		
Fig 4: *Bhanupaka*	**Fig 5: *Sthalipaka***	**Fig 6: *Putapaka***
		

Fig 7: *Cakrikas*	Fig 8: *Puta* in EMF	Fig 9: *Cakrikas* in crucible
		

The following images show Bhasma pariksha of Loha		
Fig 10: *Rekhapurna*	**Fig.11: *Varitara***	**Fig.12: *Unnama***
		
Fig.13:*Mitrapanchaka*	**Fig 14: Before *Apurnabhava***	**Fig 15:After *Apurnabhava***
		
Fig 16: *Nirdhuma*		
		

Figures 17: Images of three batches of *Loha bhasma*		
Loha bhasma A batch	*Loha bhasma* B batch	*Loha bhasma* C batch
		

Figures 18: The following image of individual ingredients of *Tryushanadya Lauha*		
1.*Pippali*	**2.*Maricha***	**3.*Shunti***
		
4.*Chitraka*	**5.*Bakuchi***	**6.*Cavya***
		
7.*Saindhava lavana*	**8.*Sauvarchala lavana***	**9.*Bida lavana***

		
10.*Aubhida lavana*	**11.*Loha bhasma***	
		

Figures 19: Images of three batches of *Tryushandya Lakha*		
TL-A	**TL-B**	**TL-C**
		

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