

## UTILIZATION OF BORAX IN THE PHARMACEUTICO-THERAPEUTICS OF ĀYURVEDA IN INDIA

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Borax, chemically known as Sodium pyroborate ( $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ ), has been used in Āyurveda since more than 2500 years. *Suśruta Saṃhitā* was first to introduce it in Āyurveda and also first to describe its pharmacological properties and actions. *Ṭaṅkaṇa*, the drug popularly known in Āyurveda is one among three best alkalis (*kṣāra-traya*) and has been extensively used in *Rasaśāstra*, the branch of Āyurveda dealing mainly with herbo-mineralo-metallic preparations; both as a therapeutic agent and a pharmaceutical agent in the various processing techniques of *rasauśadhis* like purification (*śodhana*), incineration (*bhasmīkaraṇa/māraṇa*) and metal extraction (*sattvapātana*) etc since 8<sup>th</sup> century AD onwards even through its use in alchemical processes were prevalent from 8<sup>th</sup> – 13<sup>th</sup> century AD. The earliest uses were for skin, aphrodisiac applications and fever. The combinational use of aconite and borax to increase the safety profile of aconite in therapeutics was advocated clearly during 17<sup>th</sup> century in the book *Āyurveda Prakāśa*, although such usage was prevalent before. Dosages for its external uses on skin evolved from powder, paste to lipid formulations (*sneha kalpanās*) and later ointments. An effort has been made to compile the major pharmaceutico – therapeutic uses of borax from the ancient to modern period, with the historical perspective by referring all the important texts of Āyurveda with a special screening through the texts of *Rasaśāstra*.

**Key words:** Āyurveda, *Kṣāra*, *Rasaśāstra*, Skin diseases, *Ṭaṅkaṇa*

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### INTRODUCTION

Known for its extensive commercial use in manufacturing of glass and enamels,<sup>1</sup> borax which is commonly known as *Ṭaṅkaṇa* has been used in Āyurveda since the period of *Suśruta Saṃhitā* (c. 3<sup>rd</sup> century BC)<sup>2</sup>, an ancient classic of Āyurveda. Besides the popular name *Ṭaṅkaṇa*, it is also known with different synonyms like *Saubhāgya*, *Raṅga*, *Raṅgada*, *Taṅgaṇa*, *Taṅga*, *Loha śodhana*, *Svarṇa śodhana*, *Sita kṣāra*, *Dhātu drāvaka*, *Kṣāra rāja* and *Kṣāra ratna* etc. in Āyurveda<sup>3</sup> while known as *Suhāga* in Hindi.

In this article, an effort has been made to compile and present the utilization of borax in the phramceutico – therapeutics of Āyurveda from the historical perspective, by referring important texts of Āyurveda which includes *Caraka Saṃhitā* (CS) of c. 5<sup>th</sup> century BC, *Suśruta Saṃhitā* (SS) of c. 3<sup>rd</sup> century BC, *Aṣṭāṅga Saṃgraha* (AS) and *Aṣṭāṅga Hṛdaya* (AH) of 6<sup>th</sup> century AD, *Rasendra Maṅgala* (RM) of 8<sup>th</sup> Century AD, *Rasārṇava* (RNV), *Rasa Hṛdaya Tantra* (RHT) and *Rasendra Cuḍāmaṇi* (RCu) of 12<sup>th</sup> century AD, *Rasaprakāśa Sudhākara* (RPS) of 12<sup>th</sup>-13<sup>th</sup> century AD, *Rasa Ratna Samuccaya* (RRS) of 13<sup>th</sup> century AD, *Rasendra Cintāmani* (Rci) and *Basavarājīyam* (BSVR) of 15<sup>th</sup> -16<sup>th</sup> century AD, *Rasendrasāra Saṃgraha* (RSS) of 16<sup>th</sup> century AD, *Āyurveda Prakāśa* (AP) and *Yoga Ratnākara* (YR) of 17<sup>th</sup> century AD, *Bhaiṣajya Ratnāvalī* (BR) of 19<sup>th</sup> century AD, *Rasa Taraṅgiṇī* (RT) and *Rasāmṛta* (RMT) of 20<sup>th</sup> century AD. In all aspects of its uses, original contributory authors and period have been tried to be traced, and an attempt has been done to cover the maximum area of utilization with a less emphasis on the duplication of its uses in later period.

### GROUPING AND CATEGORIZATION OF BORAX

Borax has been considered as one of the three important alkalis (*kṣāra-trayas*)<sup>4</sup> in the all most important Āyurvedic texts wherever it is mentioned except in the earliest one *Suśruta Saṃhitā*. Suśruta has mentioned five different *kṣāras* namely *yava*, *sarja*, *oṣa*, *pāki* and *ṭaṅkaṇa* in 46<sup>th</sup> chapter of *Sūtrasthāna* while describing different *kṣāras*, however he has not made any group based on numbers. Apart from this, other major groups under which borax is categorized in different texts include eight alkalis (*kṣārāṣṭka*),<sup>5</sup> five metal accumulators (*mitra pañcaka*),<sup>6</sup> group of melting agents (*drāvaka gana*),<sup>7</sup> group of purifiers (*śodhanīya gana*)<sup>8</sup> and three best

purifiers (*śodhana tritaya*)<sup>9</sup>. *Rasārṇava*, the *Rasaśāstra* classic of 12<sup>th</sup> century AD terms *Mitrapañcaka* as *Drāvaka pañcaka* (five melting agents) which includes borax, *Abrus precatorius*, honey, ghee, and jaggery.<sup>10</sup> and he is first to include borax under *kṣārāṣṭaka*, but the group with this name does not contain borax in the latter works. *Rasendra Cūḍāmani* groups borax under the group beginning with *Musa paradisiaca* (*kadalyadi varga*) which is a group of drugs meant for aiding the melting of metals (*Loha drāvana*).<sup>11</sup> *Bhāvaprakāśa* (16<sup>th</sup> century AD), an Āyurvedic lexicon considers it under *Uparasa* (sub-mercurials) group of *Rasaśāstra* drugs while *Āyurveda Prakāśa* (17<sup>th</sup> century AD) is the first *Rasaśāstra* text to consider it under this group and also it includes in group of alloying drugs (*Dvandva melāka auṣadha*).<sup>12,13</sup>

Until 17<sup>th</sup> century AD, there were no different varieties in borax. During 17<sup>th</sup> century AD, the *Āyurveda Prakāśa* quoted two types of borax, one whitish and the other bluish which is considered to be the best.<sup>14</sup> This classification is not seen in other texts of Āyurveda and the white variety is the only kind used at present.

#### PURIFICATION OF BORAX

Purification (*śodhana*) is an integral part of Āyurvedic processing especially when metals and minerals are used in therapeutics. There were no descriptions about poisoning effects and method of purification of raw borax even in the most revered book of *Rasaśāstra*, *Rasa Ratna Samuccaya* of 13<sup>th</sup> century AD. The purification of borax appears to be started during 15<sup>th</sup>-16<sup>th</sup> century AD as it was found in the *Basavarājīyam*. It has given an easy method of purification, i.e. to immerse in the juice of *Citrus medica* and to keep in sunlight for one day.<sup>15</sup> The commonest and easy method followed in present day practice is first found in *Āyurveda Prakāśa* of 17<sup>th</sup> century AD and it also explained the hazardous effects of use of unpurified borax. As per *Āyurveda Prakāśa*, borax, if used without purification, causes vomiting and giddiness. The method of purification is dry frying until all watery content is evaporated, characterized by the complete blooming of the borax crystals<sup>16</sup> and producing a kind of cracking sound when pressed between the fingers. This process turns crystalline nature of borax into amorphous. Later in 20<sup>th</sup> century AD, *Rasa Taraṅgiṇī* advocated a pre-*śodhana* procedure, termed to

be *nirmalīkaraṇa* (cleansing) in which borax is dissolved in 24 parts of water and the watery part is decanted, and it is heated on fire, and on being semisolid it should be dried in sun rays and be used.

#### PHARMACOLOGICAL PROPERTIES AND ACTIONS

As per *Suśruta's* descriptions, borax is dry (*rūkṣa*) and piercing (*tīkṣṇa*) in quality, and increases *vāta doṣa*, vitiates *pitta doṣa*, pacifies *kapha* in the body and increases digestive power.<sup>16</sup> But later till 15<sup>th</sup> century AD there were no much descriptions with regard to pharmacological properties and actions mentioned specifically about *Ṭaṅkaṇa* although it was extensively used in various formulations. Almost similar properties that explained in *Suśruta saṃhitā* were attributed in the works after 15<sup>th</sup> century AD. *Rasendra Sāra Saṃgraha* (16<sup>th</sup> century AD) and *Bhaiṣajya Ratnāvalī* (19<sup>th</sup> century AD) opines it to possess purgative (*recana*) action.<sup>17,18</sup> Antitoxic (*viśahara*) and cardiotoxic (*hṛdya*) actions have been attributed to borax in *Āyurveda Prakāśa* of 17<sup>th</sup> century. *Rasa Taraṅgiṇī* has given an extensive description on borax, describes as it to possess pungent (*katu*) taste, dry, piercing and mobile (*sara*) qualities. It expels *kapha*, alleviates *vāta* diseases, cough (*kāsa*), asthma (*śvāsa*), subsides the effects of poisons, carminative, pacifies distention of abdomen (*ādhmāna*), induces menstruation, increases strength, clears the constipation, heals the ulcers, increases *pitta*, eases delivery in case of malpresentation of the foetus (*muhagarbha*), and is aphrodisiac and good for heart.<sup>19</sup>

#### THERAPEUTIC ADMINISTRATIONS OF BORAX

Borax is administered both externally and internally. The major areas of its usage in current practice as an important drug include skin, respiratory disorders and gastrointestinal disorders. However there are number of other conditions mentioned in *Āyurveda* classics where borax is therapeutically potential.

##### External applications

*Rasendra Maṅgala* (8<sup>th</sup> century AD) of Nāgārjuna, the pioneer of *Rasaśāstra*, has given certain applications (*lepa*) containing borax to treat skin diseases; for increasing sexual vigour in males and to act as good

libertines for females (*strī drāvāna*).<sup>20</sup> Skin has been the main therapeutic area of borax since the beginning and the dosage forms have changed over the due course of period. The powders and pastes of borax with other herbo-mineral drugs were used in the early period of *Rasaśāstra* and the same practice sustained for centuries. During 11<sup>th</sup> century AD *Cakrapāṇidatta* introduced its use in *Cippa roga*, a disease of nail categorized under minor ailments (*kṣudra roga*) and application of borax with root of *Hemidesmus indicus* (*Aspota mula*) is useful in it.<sup>21</sup> Later around 17<sup>th</sup> century certain lipid formulations (*sneha kalpanās* like medicated oils and ghee) were prepared as documented in *Yoga Ratnākara*. During 20<sup>th</sup> century certain ointment (*malahara*) preparations were developed as evidenced in the text *Rasa Taraṅgiṇī*. Various external administrations have been advised in this text.

Purified borax and purified alum (*spaṭikā*) dissolved in water is useful in washing of chronic eczema, even in oozing variety.<sup>22</sup> Sprinkling of purified borax is useful in condition of external bleeding. Application of borax mixed with honey is useful in stomatitis. In case of vaginal injuries or in diseases like gonorrhoea and leucorrhoea, washing of vagina with borax dissolved water is advised. For wound healing purpose, application of borax mixed with old jaggery is beneficial. In pityriasis versicolor (*sidhma*), application prepared with borax and sandalwood (*Santalum album*) is advised to be useful.<sup>23</sup> Slowly rubbing borax mixed with *Commiphora myrrha* (*bola*) can cure the gum disorders like bleeding gum and oedema of the gum etc.<sup>24</sup>

Certain ointments and other topical formulations are prepared using borax as one of the ingredients to treat skin diseases. *Ṭankaṇāmṛta malahara*<sup>25</sup> is an ointment prepared using *Siktha taila* (an oil prepared with resin of *Shorea robusta* and sesame oil), *Sarja kṣāra* (sodium bicarbonate), green vitriol (*kāsīsa*), *Asvattha tvak kṣāra* (alkali prepared from the bark of *Ficus religiosa*) and with the major proportion of the drug, borax. It is advised to be used in cleaning chronic ulcers. Other external remedies of borax include *Gandhakādi Yoga*<sup>26</sup> in *Ganaḍāla* (scrofula), *Svarjikādi Ghṛta*<sup>27</sup> in ulcer (*Vṛna*), *Gandhakādya malahara*<sup>28</sup> in severe scabies (*Dārūna Pāma*) and *Tutthadyāko malahara*<sup>29</sup> for cleansing of ulcers (*Vṛna śodhana*). A formulation *Tālakesvara rasa*, composed of *Emlica officinalis*, arsenic trisulphide and borax is found to be anti-bacterial against *Staphylococcus aureus* and *Pseudomonas aeruginosa*.<sup>30</sup>

### Internal administration

Several formulations containing borax as an ingredient are found in Āyurvedic literature. Some of them with their indications are tabulated in Table 1.

**Table 1. Some of the Borax containing formulations for internal administration and their indications**

S. No.	Formulation	Indication	Reference	Period of the text
1.	<i>Svacchanda bhairava rasa</i>	Vāta diseases	RM 3.21-22	8 <sup>th</sup> century
2.	<i>Jayamaṅgala rasa</i>	Sannipāta (all three doṣa) diseases	RM 3.9-10	8 <sup>th</sup> century
3.	<i>San̄koca sūtaka rasa</i>	Leucoderma ( <i>Āvitra</i> )	RM 3.87-90	8 <sup>th</sup> century
4.	<i>Pratāpa Lan̄keśvara rasa</i>	All skin diseases	RM 124-125	8 <sup>th</sup> century
5.	<i>Sūrya rasa</i>	Fever ( <i>Jwara</i> )	RPS 8.20	12 <sup>th</sup> -13 <sup>th</sup> century
6.	<i>Kanaka Sundara rasa</i>	Indigestion ( <i>Agnimāndhya</i> )	RPS 8.33-34	12 <sup>th</sup> -13 <sup>th</sup> century
7.	<i>Vajra kapāṭa rasa</i>	Acid peptic disorders ( <i>Grahani</i> ), Diarrhoea	RPS 8.43-49	12 <sup>th</sup> -13 <sup>th</sup> century
8.	<i>Trinetra rasa</i>	Haemorrhoids	RPS 8.63-64	12 <sup>th</sup> -13 <sup>th</sup> century AD
9.	<i>Mehāri rasa</i>	Diabetis mellitus ( <i>Prameha</i> )	RPS 8.197	12 <sup>th</sup> -13 <sup>th</sup> century
10.	<i>Siddha Pañcānana rasa</i>	Skin diseases, Oedema	RPS 8.204-205	12 <sup>th</sup> -13 <sup>th</sup> century AD
11.	<i>Kṛmi virecanī vaṭi</i>	Worms ( <i>Kṛmi</i> )	RPS 8.228-230	12 <sup>th</sup> -13 <sup>th</sup> century
12.	<i>Tālaka raja rasa</i>	Rejuvenation ( <i>Rasāyana</i> )	RPS 260-264	12 <sup>th</sup> -13 <sup>th</sup> century
13.	<i>Kaphaketu rasa</i>	<i>Kapha</i> diseases	RSS <i>Kapharoga</i> 30-32	13 <sup>th</sup> century
14.	<i>Ānanda Bhairavī rasa</i>	Fever	RSS <i>Jvara</i> 2/103-105	13 <sup>th</sup> century
15.	<i>Rāja Mṛgāṅka rasa</i>	Tuberculosis ( <i>Yakṣma</i> )	RSS <i>Yakṣma</i> 3-7	13 <sup>th</sup> century
16.	<i>Viangādi Lauha</i>	Worms	RSS <i>Kṛmi</i> 26-27	13 <sup>th</sup> century
17.	<i>Mahājvarankuśa rasa</i>	Fever	BSVR <i>Jvara</i>	15 <sup>th</sup> -16 <sup>th</sup> century

contd...

S. No.	Formulation	Indication	Reference	Period of the text
18.	<i>Āmavatari vaṭi</i>	Rheumatism ( <i>Āmavāta</i> )	<i>RCi</i> 9. 6-8	15 <sup>th</sup> -16 <sup>th</sup> century
19.	<i>Icchābedhī rasa</i>	Ascities ( <i>Udara</i> )	<i>RCi</i> 9. 30-31	15 <sup>th</sup> -16 <sup>th</sup> century
20.	<i>Śankha vaṭi</i>	<i>Grahani</i> , Abdominal pain ( <i>Śūla</i> )	<i>RCi</i> 9. 16-17	15 <sup>th</sup> -16 <sup>th</sup> century
21.	<i>Kasturī Bhairava rasa</i>	Fever	<i>RSS</i> 3.276	16 <sup>th</sup> century
22.	<i>Sobhagya vaṭi</i>	Excess sleep ( <i>Atinidra</i> ) Asthma ( <i>Śvasa</i> )	<i>RSS</i> 3.288	16 <sup>th</sup> century
23.	<i>Viṣa Vajrapāta rasa</i>	Poisonings ( <i>Viṣa</i> )	<i>AP</i> 6.119 – 121	17 <sup>th</sup> century
24.	<i>Śvāsa Kutāra rasa</i>	Asthma	<i>YR Kāsa śvāsa</i>	17 <sup>th</sup> century
25.	<i>Vāta Vidvaṃsana rasa</i>	Neurological disorders ( <i>Vātavyādhi</i> )	<i>YR Vātavyādhi</i>	17 <sup>th</sup> century
26.	<i>Sūta Śekara rasa</i>	Hyperacidity	<i>YR Amlapitta</i>	17 <sup>th</sup> century
27.	<i>Gagana Sundara rasa</i>	Fever	<i>BR Jvara</i> 69-71	19 <sup>th</sup> century
28.	<i>Raja pravartinī vaṭi</i>	Dysmenorrhoea	<i>BR Strīroga</i> 58-59	19 <sup>th</sup> century
29.	<i>Mṛtyunjaya rasa</i>	Fever	<i>BR Jvara</i> 400-418	19 <sup>th</sup> century
30.	<i>Vāta Gajānkuṣa rasa</i>	<i>Vāta</i> diseases	<i>BR Vātavyādhi</i> 488-492	19 <sup>th</sup> century
31.	<i>Śankha Drāvaka</i>	Splenomegaly	<i>BR Plīha</i> 193-197	19 <sup>th</sup> century
32.	<i>Saubhāgya vaṭi</i>	Fever	<i>BR Jvara</i> 474-475	19 <sup>th</sup> century
33.	<i>Lavagādi cūrṇa</i>	Morning sickness	<i>BR Strīroga</i> 306-310	19 <sup>th</sup> century
34.	<i>Agnitundī vaṭi</i>	Dyspepsia	<i>BR Agnimāndya</i> 117-118	19 <sup>th</sup> century
35.	<i>Ṭaṅkaṇa yoga</i>	Diarrhoea	<i>RT</i> 12.27	20 <sup>th</sup> century

As per *Yoga Ratnākara*, *Piper longum*, *Emblia ribes* and borax made to a powder in equal quantity and if taken in the milk during the period of fertilization there will be no conception.<sup>31</sup> Some of the other internal administration of borax mentioned in Āyurveda as per *Rasa Taraṅgiṇī* include, chewing the powder of purified borax in case of dysphonia (*Svara rodha*); intake with *Trikaṭu* (equal combination of *Piper nigrum*, *Piper longum* and *Zingiber officinale*) and purified *Croton tiglium* (*jayapāla*) as a purgative

in ascities; with *Trikatu* and honey in distention of abdomen, with *Caryophyllus aromaticus* (*lavanga*), *Zingiber officinale* (*śunti*), *Piper nigrum* (*marica*) for easily digestion of heavy non-vegetarian food etc.<sup>32</sup>

### As an antidote

Borax has the capacity to nullify the effects of poisonings of all varieties.<sup>17</sup> Particularly, borax is known as an antidote for aconite (*Vatsanābha*) poison.<sup>33</sup> Due to this antidotal effect, *Āyurveda Prakāśa* advocated triturating aconite with equal quantity of borax and it can be used in all conditions without any risk of aconite complications.<sup>34</sup> *Yogarātnākara* advised to mix equal quantity of borax and double quantity of *Piper nigrum* to nullify any untoward effects of aconite.<sup>35</sup> It is also interesting to note that majority of aconite containing formulations contains borax also as an ingredient in it like *Agnituni vaṭi*, *Ānanda Bhairava Rasa* and *Śvāsa Kumāra Rasa* etc. Although this aconite-borax combination was seen in the formulations before 17<sup>th</sup> century, *Āyurveda Prakāśa* clearly declared borax as an antitoxic (*vicahara*) and an antidote to aconite. As per *Āyurveda Prakāśa*, for subsiding the toxicity effects *kañkuṣṭha* (Mysore gambosse tree – *Garcinia morella*), decoction of root of *Acacia nilotica* (previously known as *Acacia arabica*, Babbula), *Cuminum cyminum* (*Jīraka*) and purified borax are advised to be taken internally as suggested by the same text.<sup>36</sup> *Rasa tarāṅgiṇī* suggested other few similar administrations like in case of nausea due to complications of intake of mercurial preparations, borax dissolved in 24 parts of warm water is advised for gargling.<sup>37</sup> In order to induce vomiting, borax mixed with purified copper sulphate (*Śodhita Tuttha*) and juice of *Zingiber officinale* (*Ardraka*) is to be given.<sup>38</sup>

### PHARMACEUTICAL POTENTIAL OF BORAX

Along with its therapeutic role, borax is equally known for its role as a pharmaceutical adjuvant in different processing techniques involved in the manufacturing of *Rasauśadhis* like *śodhana*, *māraṇa* (*bhasmīkaraṇa*) and *sattvapātana* etc.

### As a purification agent

*Śodhana* (purification) in *Āyurvedic* pharmaceuticals is not only referred to elimination of unwanted materials from the drug but can also include the

enhancement or addition of therapeutic properties in it. *Borax*, grouped under *Śodhanīya gaṇa*, is useful in purification of metal extracts (*sattva*), solidified mercury (*baddha sūta*) and metals (*loha*).<sup>39</sup> In 8<sup>th</sup> century, *Rasendra maṅgala* has described a general method for the purification of all *Rasa* drugs as to triturate the drug with alkalis (*kṣāra*), lipid (*sneha*) and sour (*amla*) media in order. Borax being one of important alkali, it is an obvious choice in purification of *Rasa* drugs. Silver is the first drug for which borax is specifically mentioned for purification in this book. Silver is purified by melting it with borax in crucible subjecting to high temperature and immersed in *Celastrous paniculata* (*Jyotiṣmati*) oil. Heating and immersing should be done three time totally by which silver gets purified.<sup>40</sup> In the purification of mica extract (*abhraka sattva*), *Śodhana tritaya* which includes borax is used in *Rasendra Cūdamaṇi* of 12<sup>th</sup> century AD.<sup>41</sup> *Āyurveda Prakāśa* gave a method of purification of Copper sulphate (Blue Vitriol - *tuttha*) which also involves the use of borax.<sup>42</sup> It also claims that borax is best drug for purification of gold and silver. It may be noted here that borax has a synonym of *svarṇa śodhaka* meaning the purifier of gold. In 20<sup>th</sup> century as per *Rasa Tarangiṇī*'s description, Arsenic trioxide (*Gaurīpācaṇa / Malla*) is purified by boiling it in the media of borax dissolved in water in *Dolāyaṅtra* (an instrument for boiling in which liquid media is taken in vessel and the drug enclosed in a cloth is immersed completely in it and cloth is tied to a rod placed across the neck of the vessel).<sup>43</sup> Borax is used in certain methods of purification of mercury explained in *Rasa Tarangiṇī*.<sup>44</sup>

Besides specific advocations of borax in above mentioned purification processes, there are many drugs for which alkalis (*kṣāra*) are used for the purification process. Borax being one of the three important alkalis and a member of *śodhanīya* group, it qualifies to be used at such instances though borax is not specifically mentioned. Certain drugs which involves the specific use of *kṣāra* include black bitumin (*śilājatu*)<sup>45</sup>, Lapis lazuli (*rajāvarta*)<sup>46</sup>, copper (*tāmra*),<sup>47</sup> and magnetite (*kāntaloḥa*)<sup>48</sup> etc.

#### **As an incineration agent:**

*Bhasmīkaraṇa* or *māraṇa* is the process of converting the drug into ash. To ease the process of incineration and inculcate therapeutic properties, certain adjuvants are mixed with the drug before the process of *bhasmīkaraṇa*.

**Table 2. Bhasmas of Āyurveda involving the use of Borax in their manufacturing**

S. No.	Name of Bhasma	Processing Materials	Reference
1.	<i>Vajra</i> (Diamond) Bhasma	Purified Copper pyrite, <i>Grymema sylvestre</i> , Purified Realgar, Purified Sulphur, Purified Borax, purified Tourmaline ( <i>Vaikranta</i> ), Purified orpiment, Latex of <i>Euphorbia nerifolia</i> .	RNV 6.85-86
2.	<i>Tuttha</i> (Blue Vitriol) Bhasama	Purified Sulphur, Purified Borax, <i>Artocarpus lakoocha</i> bark juice	RCu 10.76
3.	<i>Abhraka</i> (Mica) Bhasma	<i>Curcuma longa</i> , <i>Emblica officinalis</i> , Purified Borax	RRS 2.19
4.	<i>Kāṃsa</i> (Bronze) Bhasma	Alkali of <i>Hordeum hexasticum</i> , Sodium bicarbonate ( <i>Sarja kṣāra</i> ), Purified Borax Rock salt, Sea salt, Ammonium chloride ( <i>Vida lavaṇa</i> ), black salt ( <i>Souvarchala lavaṇa</i> ), Lack salt ( <i>Romaka lavaṇa</i> ), juice of <i>Citrus lemon</i>	RRS 5.211

*Vajra bhasma* is the first *bhasma* mentioned to be involving the use of borax. *Bhasmas* which are prepared using borax are tabulated in Table 2.

*Āyurveda Prakāśa* has given certain methods of *abhraka bhasma* preparation where borax is the most important processing agent. In one method, equal parts of *dhānyabhra* (specially processed mica after purification of it) and *śuddha ṭaṅkaṇa* are taken in mud vessel and melted under heat and poured into vessel containing cow's milk and it should be rigorously rubbed with hand simultaneously. Later contents along with milk have to be taken in mortar and triturated till it is dried completely. By this, *abhraka bhasma* characterized with lustrelessness (*niscandratva*) is prepared.<sup>49</sup> In another method described in it, one part of *dhanyābhra* and two parts of borax are taken and triturated well and put in *andha mūṣā* (a kind of crucible) subjected to strong fire and allowed to self cool after incineration. Thus *abhraka bhasma* is prepared.<sup>50</sup>

#### As a metal extraction agent

*Sattvapātana* (metal extraction) is the process of extracting the core metal from the compound. The process usually involves mixing of certain

drugs which facilitates the extraction with the high temperature of about 1200<sup>0</sup> -1800<sup>0</sup>C in the open chamber in specially designed heating apparatus called *koṣṭi*. *Sattvapātana* was first introduced in the 8<sup>th</sup> century by Nāgārjuna as documented in *Rasendra maṅgala*. Borax is one of integral composition of adjuvants used in the general method of *sattvapātana* of *Rasa* drugs.<sup>51</sup> Some of the drugs of which metal extraction is done using borax, with classical reference are tabulated in the Table 3.

**Table 3. *Sattvapātana* involving the use of Borax in the process.**

S. No.	<i>Sattvapātana</i> Drug	Reference
1.	Copper pyrite ( <i>maḡṣika</i> )	RM 2.28
2.	Zinc carbonate( <i>kharpara</i> )	RM 2.32 -33
3.	Orpiment ( <i>haratāla</i> )	RM 2.38
4.	Iron pyrite ( <i>vimala</i> )	RNV 7.16 -18
5.	Blue vitriol ( <i>sasyaka</i> )	RCu 10.77
6.	Realgar ( <i>manahṣilā</i> )	RCu11.60
7.	Lead and Antimony ore ( <i>aṅjana</i> )	RCu 11.68
8.	Mica ( <i>abhraka</i> )	RPS 5.30
9.	Tourmaline ( <i>vaikrānta</i> )	RRS 2.69 -72
10.	Ochre ( <i>gairika</i> )	RRS 4.12
11.	Lapis lazuli ( <i>rajāvarta</i> )	RRS 4.10
12.	Earthworm ( <i>bhūnāga</i> )	RRS 5.220 -221
13.	Peacock's feather ( <i>mayūra picchā</i> )	RT 17.123

*Āyurveda Prakāśa* advises that along with *sattvapātana*, for accumulation (*ekīkaraṇa*) of *abhraka sattva*, borax is used with other drugs of *Mitrapañcaka*.<sup>52</sup>At this context, the author claims that it applies to all metals.

#### **As a *Pārada Saṃskara* agent**

Mercury is the centre of *rasa* pharmaceuticals. To make it therapeutically more potent and to make ready for further processing, there are 18 *saṃskāra* (quality modifying techniques) mentioned in ancient

*Rasaśāstra* classics. In *Rasendra Maṅgala*, there is use of *kṣāra* for *rodhana* (*bodhana*) (6<sup>th</sup> *saṃskāra*) that is intended to increase the potency (*vīrya*) of mercury, although there is no specific mention of borax in it. Some of the *saṃskāras* which uses the borax for the process are tabulated in Table 4.

**Table 4. Pārada Saṃskāras involving the use of Borax**

S No	Name of <i>Samskara</i>	Reference
1.	<i>Sancāraṇa</i> (mobilization)	<i>RNV</i> 11.24
2.	<i>Krāmaṇa</i> (targetted movement)	<i>RHT</i> 17.3-5
3.	<i>Mūrchana</i> (swooning)	<i>RCu</i> 7.40
4.	<i>Dīpana</i> (appetising)	<i>RCu</i> 15.56
5.	<i>Niyamana</i> (restraining)	<i>RRS</i> 11.47
6.	<i>Utthāpana</i> (regaining of mercury)	<i>RT</i> 6.64

#### As a *Bhasma* testing reagent

*Niruttha* is one of the important test for *bhasmas* of metallic origin in which prepared *bhasma* is incinerated with *mitrapañcaka* and if there is no lump or mass of *bhasma* particles after incineration, indicating the absence of free metallic particles, the *bhasma* is considered to be good and completely processed. The test was prevalent since 12<sup>th</sup> century as found in *Rasārṇava* and texts of latter period.

Apart from these, certain other alchemical processes which are not much seen in current *Āyurveda*, also involve the use of borax like *vajra drāvīkaraṇa* (melting of diamond)<sup>53</sup>, *tālaka drāvaṇa* (melting of Orpiment/ Arsenic trisulphide)<sup>54</sup>, *svaṇa drāvaṇa* (melting of gold)<sup>55</sup>, *ratna drāvaṇa* (melting of gems)<sup>56</sup>. Another important process with the use of borax is in alloying (*dvaṇḍva melāpana*) like *svaṇābhra* (alloy prepared with gold and mica)<sup>57</sup>, *vaṅgābhra* (alloy of Tin and Mica)<sup>58</sup>, and *sarvadvaṇḍva melāpana* (alloying of all metals together)<sup>59</sup>. *Rasārṇava* has mentioned a unique use of borax in a combination of paste application to crucible (*mūṣā*) for increasing the colour of *Rasa* drugs in which it is processed.<sup>60</sup> *Rasa Hṛdaya Tantra* has used borax for colouring of copper (*tāmra rañjana*).<sup>61</sup> These alchemical practices were prevalent during 8<sup>th</sup> -13<sup>th</sup> century AD as these are found mainly in the texts like *Rasendra Maṅgala*, *Rasārṇava* and *Rasa Hṛdaya Tantra* etc of this period.

### DISCUSSION AND CONCLUSION

Borax categorized under one of the three important alkalis has been found used in Āyurveda since more than 2500 years. Among the *bṛhatrayīs*, only *Suśruta Saṃhitā* mentioned it. Even Suśruta has not given much reference in treatment of diseases, indicating that although it was known during his period, it was less used. The commentators of *Caraka Saṃhitā* and *Aṣṭāṅga Hṛdaya* have referred in very few contexts. The absence in these classics and very minimum references in even in *Suśruta Saṃhitā* also creates a scope for a suspicion that whether it has been added by Nagārjuna, the redactor of *Suśruta Saṃhitā* in the later period. But there are no much arguments available to substantiate it.

An extensive use of borax has been seen in classics of *Rasaśāstra* including those in the early period of evolution of this branch in Āyurveda like *Rasendra Mangala*, *Rasa Hṛdaya Tantra* and *Rasārṇava*. Initially it was much used in alchemical and pharmaceutical purposes like some of the potentizing processes of mercury (*pārada saṃskāra*), solidification of mercury (*pārada bandha*) and alloying techniques (*dvandva melāpana*), purification (*śodhana*) of *Rasaśāstra* drugs, incineration (*bhasmīkarṇa*) and metal extraction (*sattvapātana*) and were much prevalent during 8<sup>th</sup> -13<sup>th</sup> century. Later the use of borax continued in pharmaceutical processes like *śodhana*, *māraṇa* and *sattvapātana* till now. In *Rasaśāstra*, this juncture is known for major shift of its course from alchemical to therapeutic purposes. Use of borax in preparation of *vajra bhasma*, *abhraka bhasma*, *tuttha bhasma* and *kaṃsya bhasma* were seen in this period. There were no additions to list in the later period. Until 15<sup>th</sup> century, there were likely to be no specific methods for the purification of borax. *Basavarājīyam* of 15<sup>th</sup> -16<sup>th</sup> gave a method to purify it and *Āyurveda Prakāśa* and *Rasa Taraṅgiṇī* have other methods for the purification. The dehydration which is simple *śodhana* technique employed to purify borax and because of easiness of the process, it could not been have mentioned in the earlier texts.

Borax is one of the drugs in group of melting agents (*drāvaka gaṇa*) which helps in easy melting of metals on subjection to high temperature of heat. Because of this metal liquefaction ability, borax is widely found used in *sattvapātana* processes referred in majority of *Rasaśāstra* classics. With the same principle, it is useful in some of *bhasma* preparations where the

drugs are reduced into ash. Borax is expected to reduce the melting point of the metals with which it is subjected to heating and thus helping in easy dissociation and ashing.

Alkalis are known for their cleansing property.<sup>62</sup> Hence purification of many *Rasa* drugs involves alkalis. Borax is a better option wherever purification of *Rasa* drugs needs alkalis as borax is one of three major alkalis and also one of three best purifying agents (*śodhana tritaya*).

With regard to evolution of therapeutic utilization of borax, there are no descriptions traced to treat specific disease in *Suśruta's* period. The description that it is a digestive and external use of alkalis in various diseases in the classic gives an idea that it was used both internally and externally since the beginning. Earliest and clear mentions of treating specific conditions are found since 8<sup>th</sup> century in the text *Rasendra Maṅgala*. Applications on skin and aphrodisiac pastes were initial external use of borax seen while certain formulations for internal administration to treat fever, skin diseases, diseases of *vāta* and *sannipāta* (all three *doṣa*) origin were also in the same period. Initially and for larger period of time, mere paste or powders of borax with other herbomineral drugs were used for skin applications. Newer dosage forms containing borax like *sneha kalpas* (lipid formulations) was found during 17<sup>th</sup> century while *malahara* (ointments) were in seen in modern period. During 12<sup>th</sup> – 13<sup>th</sup> centuries, borax was used in the formulations used for indigestion, fever, worms, diarrhoea, acid peptic disorders, hemorrhoids, diabetes mellitus, emaciation, skin diseases, and even for rejuvenation. During 15<sup>th</sup>-16<sup>th</sup> century, it was found to have used in treating insomnia, asthma and rheumatism etc. Its use in treating poisonous conditions was seen during 17<sup>th</sup> century and in menstrual disorders was seen in 19<sup>th</sup> -20<sup>th</sup> century. There are additions in the therapeutic uses of borax over the period of time and older uses are found to be preserved.

Among the important texts of *Āyurveda*, *Āyurveda Prakāśa*, *Rasa Taraṅgiṇī* and *Rasāmṛta* were three to describe borax in detail. *Āyurveda Prakāśa* was to first to describe the hazardous effects of unpurified borax on administration. It is the same book to attribute antitoxic and cardiogenic properties to borax. There were formulations containing aconite and borax even before 17<sup>th</sup> century, but *Āyurveda Prakāśa* made clear it that the use of aconite with borax enhances the safety profile of administration of aconite.

In spite of earnest efforts, this exercise may have discrepancies from historical perspective due to some of the constrains of the reviewing like manual search through the print versions of the texts as most these remain undigitalized so far, many synonyms with which the drug is known, referral of quite a large number of books of larger period of time comprising of large number of therapeutic formulations and their duplication in the latter texts, and due to controversies in the dating of texts itself.

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