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Review Article

A review through therapeutic attributes of Ayurvedic formulation *mashi*

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ABSTRACT

Mashi is a black colored powder formulation obtained after combustion of the plant or animal drug. It is prepared by *bahirdhum padhati* (outside) or *anterdhum padhati* (in the close vessel). In this dosage form, bulk of raw material is reduced to a greater extent by the application of a certain quantum of energy. Due to this treatment, hidden chemical constituents become prominent and/or a new chemical moiety is formed which is therapeutically active. This formulation is cost-effective and easy to prepare. This review article aims to highlight the different *mashi* formulations mentioned in Ayurvedic text and also incorporate the formulation not mentioned in the Ayurvedic text but used by Ayurvedic practitioners. The objective was to introduce researchers to the simple yet excellent formulation *mashi* which should be studied in detail to establish its identity, purity, and therapeutic activity.

1. Introduction

Mashi is an important dosage form of medicine in Ayurveda. The term '*mashi kalpana*' is often used to signify a partially burned or roasted black colored powdery formulation of a plant (*Kalpana* refers to the ideology behind the method of manufacture/process).

Whenever any herbal or animal product is heated slowly, it undergoes combustion, when the specific temperature is attained. The smoke appears at the beginning of the process and the material starts blackening. Then, the typical odor of combustion is identified. Ultimately, when the whole material turns black and the smoke is completely removed, the process of formation of *mashi* is assumed to be completed. This material is made into a fine powder, which should be perfectly black like charcoal powder.

If we further heat the *mashi* after this stage, it gets converted into a white or grey colored ash and is said to have lost its '*Sendriyatva*' (organic content). This form is unpalatable for the body and is referred to as the drug's 'carbon form'. *Mashi* has a wide range of applications with some articles even claiming that it can even be used for water purification. *Bhasmikaran* process is different from the *mashi kalpana* process. *Bhasmikarana* involves *shodhana* (purification), *marana* (powdering), *chalana* (stirring), *dhavana* (washing), *galana* (filtering), *putan* (heating), and *bhavana* (coating) with the herbal extract. The selection of these steps depends on the specific metal or mineral; whereas, in *mashi* preparation, the substance is cleaned and heated either in an open vessel or closed vessel as per the Ayurvedic literature.

2. Types of *mashi*

2.1. Based on method

Broadly, there are two methods of preparation of *mashi* formulation. These methods are called '*padhati*' which stands for a 'traditional method for preparing the medicine'.

2.1.1. Bahirdhum Padhati Mashi (BPM)

In this method, the solid mixture to-be-burned is kept in an open vessel (so the name '*Bahirdhum*', where '*Bahir*' means 'outside') as shown in Fig. 1A. Combustion is carried out at a slow

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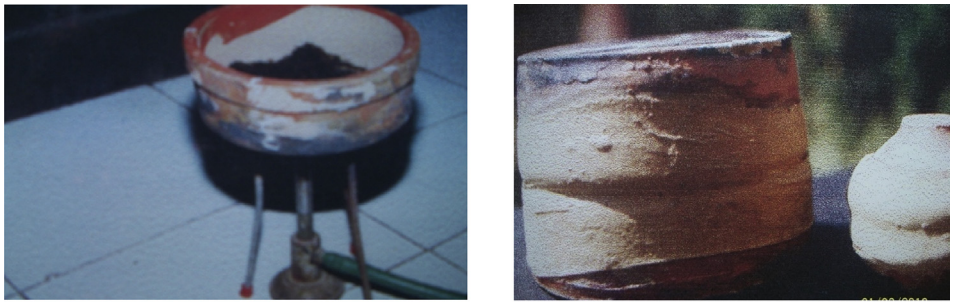

Fig. 1. Preparation of A) *Bahirdhum Padhati Mashi* B) *Anterdhum Padhati Mashi*.

pace, at a temperature of 140–150 °C with continuous agitation. The vessel used for burning is made up of iron or is earthen.

2.1.2. Anterdhum Padhati Mashi (APM)

In the APM method, the plant/animal material is packed between two '*Sharav Samputs*' (earthen pots) Fig. 1B. The two pots are joined with each other using Fuller's earth (*multani mitti*). This assembly is then subjected to the process of *puta Puta* is a pit here; two earthen pot containing the material to be heated by placing the earthen pot on heaps of cow dung cakes and setting them on fire. Once the cow dung cakes are burnt completely, the assembly is left to cool, after which, the pots are retrieved and *mashi* gets collected.

2.2. Based on material

Mashi can be prepared from plant material as well as animal material.

2.2.1. Plant mashi

As plant *mashi* formulations are available from plant material, which in turn is available more freely and can be extracted more efficiently, a good amount of research has been done on these *mashi* formulations. Another reason for this is that the plants can be easily cultivated, and hence, collecting a large number of materials for testing and/or manufacturing *mashi* never really threatens the species's survival. These *mashi* formulations can be made by both BPM and APM (see Table 1).

2.2.2. Animal mashi

These mashi formulations are derived from endangered animal species; nevertheless, their usage is strongly forbidden, and little to no study into their efficacy has been conducted. Since ancient times, animals, their parts, and their products have constituted part of the inventory of medicinal substances used in various cultures. In India, nearly 15–20 percent of Ayurvedic medicine is based on animal-derived substances. There are references to nearly 380 types of animal substances in *Charaka Samhita* [1]. Mostly, animal by-products are used in traditional health care systems without any animal loss; however, there are some *mashi* formulations which are prepared from animal body parts or whole animal such as *Hastidant mashi* is made up of elephant ivory, *Kurmakapal mashi* is made up of tortoise shell, *Chatuspaad mashi* is prepared from horns, bones or hooves of animals. As such *mashi* is made from animal parts that damage animals, strong rules are in place to ensure that no one exploits or kills them. The APM method is commonly used to produce this *mashi* (see Table 2).

3. *Mashi* prepared from plant material

3.1. Ashwagandha mashi

Ashwagandha (*Withania somnifera* L) is popular for its rejuvenation properties. The active constituents in *Ashwagandha* are withaferin-A, alkaloids, glycowithanolides, and sitoindosides VII-X. It is a member of the family Solanaceae. *Mashi* using *Ashwagandha* can be prepared by both the methods, APM and BPM. First, the roots of the plant are converted into powder form. Then, the powder is heated to prepare the *mashi*. It was found that the *mashi* had a notable presence of alkaloids, carbohydrates, saponin glycosides, and steroid glycosides, with significantly higher concentrations in ethanolic extracts than that of aqueous extracts. There was no loss of inorganic content (due to thermal degradation) in both the *mashi*; however the mashi prepared by APM method had more alkali metal content and also had siliceous sand impurities. *Ashwagandha mashi* can be used as an adaptogen to develop pain resistance as well as an immunity booster [2].

Table 1
Mashi prepared from plant materials.

Name of *mashi kalpana*	Source of raw material	Method of preparation	Use
Ashwagandha mashi	*Ashwagandha roots*	APM and BPM	Adaptogenic, immunity booster
Triphala mashi	Fruits of *amala*, *baheda* and *hirda*	APM and BPM	Antioxidants, adaptogens, chemopreventives and anti hypercholesterolemics
Amalaki mashi	*Amala* fruit	APM and BPM	Anti-ulcer
Vibhitakiydai mashi	*Bahera* fruit	BPM	Opthalmic diseases, anti-ulcer
Coconut husk *mashi*	Coconut husk	APM and BPM	Diuretic, antimicrobial, antinociceptive antiemetic
Latakaranaj mashi	*Caesalpinia bondoc* seeds	APM	Treatment of polycystic ovarian syndrome
Udumber mashi	*Ficus glomerata* bark	APM	Hiccup
Tailwak mashi	*Terminalia arjuna* bark	APM	Hiccup

Table 2
Mashi prepared from animal materials.

Name of *mashi kalpana*	Source of raw material	Method of preparation	Use
Hastidanta mashi	Ivory	APM	Hair growth
Mayurpiccha mashi	Peacock feathers	APM	Hiccup, asthma
Sarpa mashi	Black cobra snake	APM	Leucoderma
Chatuspaad mashi	Skin, hooves (*khura*), horns (*shrunga*) and bones (*asthi*) of four legs animal	APM	Hair growth
Meshadi mashi	Fleece	APM	Hiccup
Svaavida mashi	Porcupine quails	APM	Antibacterial

3.2. Triphala mashi

'*Triphala*' stands for three fruits. It is one of the most studied Ayurvedic drug and holds a prestigious place in Ayurveda and is also called 'an innovative medicine of the centuries' or 'a panacea for multiple pathological conditions' or 'the sanctifying medicine to human domain'. It is used as a constituent in more than 200 formulations in the Indian system of medicine. This *mashi* is prepared by burning the mixed, dried powders of fruits of three plants namely *Emblica officinalis*, *Terminalia belerica*, and *Terminalia chebula*. It is a polyherbal preparation that can be prepared by the BPM as well as APM. The pharmacognostic profiles of the *mashi* at different temperatures reported that only *mashi* prepared above the temperature of 400 °C are acceptable, as a proper black mass is produced only at or above that temperature. Biradar et al. conducted studies to conclude that the most optimum temperature for preparing *Triphala mashi* is 450 °C [3]. *Triphala* formulations have been reported as excellent antioxidants, adaptogens, chemopreventives, and anti-hypercholesterolemics [4,5].

E. officinalis is also known as Indian gooseberry or more popularly, '*amla*'. It is a member of the family Euphorbiaceae. *T. belerica* and *T. chebula* are called '*Bahera*' (Bastard myrobalan) and '*haritaki*' (Chebulic myrobalan) respectively. The fruits of *T. chebula* can be used in any stage of their development, meaning when they have a yellow color or black color. Both *amla* and *haritaki* have adaptogenic properties. *Triphala* is often referred to as a '*Rasayana*' in Ayurveda, which means that for day-to-day consumption, its powder is to be ingested as a mixture of ghee and honey. It is said to have the potential to regenerate organs that have become weakened. Apart from that, a wide array of medicinal applications of *Triphala* formulations have been reported [6–8] of which the research work relevant to *Triphala mashi* has been discussed.

Triphala powder contains gallic acid, methyl gallate, chebulagic acid, chebulinic acid, chebulanin acid, chebulic acid, corilagin, bellericanin, beta-sitosterol, syringic acid, luteolin, rutin, rhamnose, kaempferol, gluconins, ellagic acid, phyllembic acid, quercetin, phyllantidine, sorbitol, and ascorbic acid [9]. *Triphala mashi* has been reported to contain tannins, saponins, gallic acid derivatives and ascorbic acid and has a pronounced concentration of gallic acid [10,11].

The antimicrobial activity of *Triphala mashi* on *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* using the agar diffusion method was tested and the acute oral toxicity of the *mashi* was also determined using Swiss albino mice species. The *Triphala mashi* was produced using BPM. It was found that both aqueous and ethanolic extracts of *Triphala mashi* exhibited antimicrobial activity of broad-spectrum, while the aqueous extract showed slightly higher activity and the extracts showed dose-dependent activity. The zone of inhibition for *E. coli* and *S. aureus* was more than the standard drug. No acute oral toxicity was observed. There was mortality in the mice for the dose of 5000 mg/kg. The antimicrobial activity is largely attributed to the presence of tannins (gallic acid) and hydroxylated phenolics (like pyrogallol) in the *Triphala mashi*. The aqueous extract of the *mashi* also contained saponins. Hence, it acts synergistically to enhance the antimicrobial activity of tannins and phenols [12].

Biradar et al. studied the anti-diarrhoeal activity of *Triphala mashi* on Swiss albino mice species. The *mashi* was prepared using BPM. Diarrhea was induced in the mice using castor oil. It was observed that both, the ethanolic and aqueous extracts of *Triphala* and *Triphala mashi* produced a significant reduction in the severity and frequency of diarrhea produced by castor oil in the mice, with the ethanolic extracts having a significantly better result, along with highest first defecation time [13].

Sinha et al. studied the physicochemical properties such as total ash value, acid insoluble ash value, water-soluble ash value, loss on drying, pH and performed a chromatographic study. The antimicrobial activity of *Triphala mashi* was determined by the agar gel diffusion method. The minimum inhibitory concentration of *Triphala mashi* was compared with that of standard antibiotic ciprofloxacin (against test organism, *S. aureus* and *E. coli*). *Triphala mashi* showed a broad-spectrum antimicrobial activity against both gram-positive and gram-negative bacteria. *Triphala mashi* can be used along with honey to treat soft chancre [14].

Triphala churna can prevent/delay the onset of endotoxin-induced uveitis in rats due to its saponin content, as saponins are natural anti-inflammatory compounds. As saponins are also present in the *mashi*, it can be said that *Triphala mashi* would have a similar anti-inflammatory effect. *Triphala churna* also has anti-cancer activity and gallic acid is one of the constituents contributing to this activity [15]. Since *Triphala mashi* also contains gallic acid, it may show anti-cancer activity. As radioprotective, hepatoprotective, anti-arthritic, chemopreventive, anti-aging, and anti-mutagenic properties are also associated with gallic acid derivatives, *Triphala mashi* should be able to provide these benefits to an appreciable degree as well. As *Triphala mashi* shows antimicrobial activity, it would also contribute towards combating oral pathogens and hence, have applications in the dental industry. However further research needs to be done to support the same.

3.3. Amalaki mashi

It is prepared by BPM as well as APM. It is rich in vitamin C, tannic acid, and gallic acid [9]. This *mashi* is supposed to have application in the ethnomedical system to treat disorders like hyperacidity and abdominal distension. It is also the main ingredient of 'Charcosal', one of the propriety medicines of 'Ayurveda Rasashala' an Ayurvedic manufacturer, Pune India.

APM and BPM *amalaki mashi* was evaluated for anti-ulcer activity. An ulcer was induced in Wistar albino rats using ethanol and ranitidine was used as standard. Parameters such as gastric pH, shape, and size of the ulcers were recorded and histopathology of the stomach was performed. *Amalaki mashi* prepared by BPM method was found more effective than standard drug ranitidine in treating ulcers. This means that *amalaki mashi* can be used orally to treat/prevent ulceration of stomach mucosa. The *mashi* formulation

should be preferably prepared by the BPM method rather than the APM method. Chances are that heating in the presence of air allows the elimination of certain compounds in the *amalaki mashi* that would otherwise hinder the anti-ulcer activity or cause gastric irritation themselves. Further research needs to be done to confirm this.

3.4. Vibheetakyadi mashi

This *mashi* is prepared from *T. belerica* (*Vibheetaki* or *Bahera*). It contains gallic acid, tannic acid, rhamnose and very little amount of ascorbic acid. It is one of the ingredient of *Vibheetakyadi mashi Anjana* ('*Anjana*' means 'paste'). It contains *Vibheetakyadi mashi* along with rock salt (*saindhava*), black salt (*souvarchala lavana*), sodium salts of chloride and sulfate, and ferric sulfate. Honey was added to make a paste. An open-label clinical trial with 30 patients was performed for a month for the treatment of ophthalmic disease. Statistically significant results were obtained. It was observed that the formulation can be used to delay the onset of Pterygium and relieves symptoms in people already with the disease. This may be because the disease occurs due to a mutation (p53), whose occurrence, in turn, gets decreased due to the anti-mutagenic property of gallic acid [16].

3.5. Coconut husk mashi

Coconut husk *mashi* (*Narikela mashi*) can be prepared by both, APM and BPM methods. *Mashi* from ripe and unripe husk has been prepared and studied. Ayurvedic practitioners use this *mashi* for its anti-emetic and diuretic activity. In recent times, a considerable amount of work has been done on this *mashi*. Even though the *mashi* prepared by APM has a better yield, the *mashi* prepared by BPM has a higher content of inorganic constituents and better overall therapeutic potential. The coconut husk *mashi* contains tannins, flavonoids, potassium, sodium, and carbonates.

Baheti et al. have studied the anti-helminthic properties of green coconut husk *mashi*. This was done by testing on two worm species; *Phretima posthuma* (an earthworm species that closely resembles intestinal roundworms) and *Ascardia galli* (actual parasite obtained from freshly killed fouls). These worms were placed in stock solutions containing different concentrations of the *mashi* and the time of paralysis as well as time of death of both the worm species were noted and compared with the same times for worms placed in standard solutions of piperazine citrate (a commonly used anti-helminthic drug). The solutions containing higher concentrations (50–100 mg/ml) of the *mashi* showed comparable results as that of piperazine citrate. This anti-helminthic activity is attributed to the presence of tannins. The mechanism of killing is most likely either interference of respiration in parasites or binding of tannins to free proteins in the gastrointestinal tract of the parasites [17].

The chronic diuretic activity of BPM of unripe coconut husk *mashi* on rats has also been studied. Furosemide was used as a standard drug. *Mashi* showed dose-dependent increase in the water and electrolyte excretion in the rats, better than furosemide. This diuretic activity is reported to be associated with the significant potassium levels in the *mashi*. Rathi et al reported the dose-dependent diuretic activity of coconut husk *mashi* BPM showed good activity as compared to APM. It is possible that the higher levels of sodium, potassium, carbonate, and chloride ions in BPM contributed to its better diuretic activity [18,19].

The antinociceptive activity of APM of unripe *Cocos nucifera* husk was evaluated by Baheti et al. Coconut husk *mashi* prepared by APM was able to decrease the writhing response in albino mice. The central analgesia creating ability of APM, judged by the hot-plate method, was dose-dependent and the *mashi* seems to be targeting the opioid receptors. The reaction time of the APM-treated mice during the tail-flick test was also considerably higher. This proves that coconut husk *mashi* prepared by the APM method has a good antinociceptive activity [20].

Several studies have been carried out to evaluate the antioxidant activity of both APM and BPM of coconut husk. DPPH assay and H_2O_2 scavenging activity of the formulations was carried out. Ascorbic acid was used as a reference. It was observed that the *mashi* prepared by BPM had an antioxidant activity comparable to that of ascorbic acid. It can be used as a antioxidant, analgesic, anti-helmintic, and diuretic agent [19–21].

3.6. Latakaranj mashi

Latakaranj (*Caesalpinia bondoc* L.) is a perennial medicinal plant found in the tropical regions of India. Its seeds are typically used to prepare *mashi*. The *mashi* can be prepared by APM. The medicinally important chemical constituents of the seeds of this plant are homoisoflavonoids, hematoxylol, stereochenol A, acetylloganic acid, acetylloganic acid, and 2-glucosyloxy-4-methoxy benzene propanoic acid [22,23]. This *mashi* is used by females during their puberty, for the treatment of various problems that they face. It is also mentioned that *Latakaranj mashi* can be used to reduce pain during *Kastarthava* (painful menstruation) and also to treat polycystic ovarian syndrome.

3.7. Toor dal mashi (Pigeon peas mashi)

This *mashi* provides patients with the benefits of pigeon pea or as it is popularly called, *Toor* (*Cajanus cajan*), without the chances of having an excess accumulation of *pitta* in the body, which may cause problems like gases, acid reflux, and indigestion. This *mashi* is used by Ayurvedic practitioners and it has no textual reference available. The important constituents of pigeon pea are flavones, isoflavones, flavonols, anthocyanin, flavanone, isoflavanone, chalcone [24]. It is prepared by APM and research work regarding its therapeutic potential is yet to be conducted.

3.8. Udambar mashi

It is prepared from the bark of *Udambar* (*Ficus glomerata*). Bark contain kampferol, glycoside, sterols and ellagic acid [25]. It is cut into small pieces and burnt to black in APM method. It is supposed to be taken internally and helps during hiccups. It is supposed to be taken with honey. No research work supporting this is available.

3.9. Tailwak mashi

It is prepared from the bark of the *Arjun* tree or *Tilwak* tree (*Terminalia arjuna*). The bark of *Arjun* tree contains sterol, lactones, flavonoids, phenolic compounds, tannins and glycosides [26]. Since this *mashi* formulation comes from a plant of genus *Terminalia*, we can expect this *mashi* to have medicinal properties similar to that of *Triphala mashi* or *Vibheetakyadi mashi*. However, research work would be required to confirm this.

4. *Mashi* prepared from animal material

4.1. Hastidant mashi

The word '*Hastidant*' literally stands for 'elephant's teeth' or tusks. This *mashi* is prepared by burning elephant's tusks in *Sharav* by the APM method. The tusks are made up of ivory, which is very similar to human teeth. It is a dentine matrix, wrapped around the

enamel. This *mashi* has been frequently mentioned in the traditional Ayurvedic texts like *Sushruta Samhita* [27].

Many sources make enormous claims regarding the potency of this *mashi* in hair regeneration, when applied at any location topically. It is used to treat '*Indralupta*', which are essentially a set of diseases wherein, hair loss occurs due to varying etiology. It is also used for hair loss, hair fall, greying of hair, and other hair-related conditions. Its external application should be done by preparing a paste with sesame oil. It is one of the constituents of '*Romasanjanan lepa*', a product used to treat alopecia areata, an autoimmune hair loss disease.

Romasanjanan lepa is a *lepa* (a topical dosage form), made out of *karanja* (a plant that is often used as a biofuel), *kasisa* (an iron-containing mineral drug), *kapittha* (also called as 'wood-apple', an Ayurvedic plant), *hastidant mashi* and *narikela taila* (coconut oil). The formulation is reported to relieve scalp dryness and redness. The prospective randomized non-comparative clinical trial was conducted and it was observed that *Romasanjanan lepa's* topical application resulted in hair regrowth of 51.83% in the 30 patients over 18 months and a scalp hair loss reduction of 46.27% [28].

4.2. Mayurpiccha mashi

The word '*Mayurpiccha*' stands for a peacock's feather in Sanskrit. Hence, this *mashi* is prepared by heating the feathers of Indian peafowls (*Pavo cristatus*) by APM or by a separate method, known as ghee flame method (by simply heating in ghee flame).

The preparation of this *mashi* by APM is a complex process. After the initial *mashi* is obtained by APM, it is triturated with a decoction of *Butea monosperma* flower (*Palash* tree), then the resultant uniform mixture is converted into pellets and passed through the process of *gajaputa* again. The same procedure is repeated with the juices of medicinal herbs like *Leucas cephalotes spreng* (*Dronapuspi*) and *Senna tora* (*Chakramarda*).

No animal is harmed in the preparation of this *mashi*, as the fallen peacock feathers are abundantly available. It is often called as '*Mayurpiccha Bhasma*'. It is reported that this *mashi* contained saponins and flavonoids. The *mashi* is prepared by APM and has a 1% moisture content and is more stable than the *mashi* prepared by the ghee flame method (which has 4% moisture content). Its pH was neutral and *mashi* prepared by both the methods was rich in electrolytes like Cu, Fe, Zn, Na, K, Mg, etc. Apart from these, no tests regarding the therapeutic potential have been conducted for this *mashi*. Even though no research work related to the mechanism of action and efficacy of use for this *mashi* is available, it is the most widely used animal source *mashi*. This *mashi* is consumed internally and widely popular amongst Ayurvedic medicine practitioners. The knowledge about its chemical constituents is yet to be obtained. It is used to treat hiccups, asthma, and morning sickness during pregnancy [29,30].

4.3. Sarpa mashi

This *mashi* is prepared from black cobra. The dead cobra is collected and burned to produce *mashi*. '*Sarpa*' stands for snake or serpent in Sanskrit. It must be noted that the head, tail, and intestine of the snake are to be removed before preparing the *mashi*. It is also called '*Krishnasarpa mashi*'. The *mashi* is prepared by APM and is supposed to be consumed internally or applied externally with *bhibhitak taila*. The shredded skin of the snake can also be used to prepare *mashi* and it is used to treat leucoedema disease and a paste made from the *mashi* can be used to treat vitiligo. It is also used externally to induce labour when pregnancy is unnaturally delayed [31].

4.4. Kurmakapal mashi

The word '*Kurma*' stands for 'tortoise' and this *mashi* is prepared by burning the shell (exoskeleton) of a tortoise using APM. The shell contains calcium, phosphorous, proteins [32]. It is supposed to be applied externally to treat baldness; however, no research work related to this *mashi* is available as it not permissible to allow tortoise hunting since their various species and phyla can go extinct with extensive poaching.

4.5. Keshanjana or kesh mashi

This *mashi* is prepared by using hair from human beings, by APM. The collected hair samples have to be rubbed with *goghrita* (clarified fat from cows) before subjecting to *gajaputa*; however, the amount of fat to be used is unspecified. Mixing with clarified fat is done to ensure uniform heating and avoid charring. This *mashi* is allegedly useful during dry eye syndrome (*Shushkakshipaka*). Dhiman et al. prepared *Keshanjana* and an ointment of *Keshanjana* with petrolatum as a base. *Kesh mashi* (prepared using *goghrita*) and the petrolatum ointment were used on test subjects. Both the formulations were compared with standard medication of dry eye syndrome i.e., CMC tear supplement. Both the preparations (*Kesh mashi* and *Kesh mashi* ointment) were subjected to a study on rabbits. The study was to test ocular surface corrosion and toxicity. For this study, the OECD 405 guidelines were followed. Clinical trials on 120 patients were performed and they were randomly divided into four groups (30 members each) and studied for 1month. Group which was given 1 drop of *Kesh mashi* showed the most statistically significant results. Although the *Kesh mashi* ointment and *Kesh mashi* had the same efficacy, the *Kesh mashi* addressed the objective parameters of the patients the best [33].

4.6. Chatuspaad mashi

This *mashi* comes from *chatuspaad* (four-leg animal) [31]. The parts of the animal that can be used for preparing this *mashi* are skin, hooves (*khura*), horns (*shrunga*), and bones (*asthi*), after the animal's death. The chemical constitution of the *mashi* would also obviously depend on the type of animal and the part used. Like most animal origin *mashi*, it is also used for hair regrowth; however, no research to support that claim has been done.

4.7. Meshadi mashi

It is made from the fleece (hair) of sheep (which are vernacularly referred to as '*Mesh*'). The hair of sheep and cows are burned by APM and it is used for hiccups [31].

4.8. Svaavida mashi

This *mashi* is made from porcupine quills, by collecting them, cutting them, and then burning them in *Sharav* by APM. The quills are said to have antibiotic properties. No research work is available to support this claim. This *mashi* is supposed to be consumed internally along with sugar syrup or honey as a vehicle [31].

5. Effect of heat treatment

Mashi is a dosage form in which the bulk of raw material is reduced to a greater extent by the application of a certain quantum of energy. Due to this treatment, hidden chemical constituents become prominent and/or a new chemical moiety is formed which is therapeutically active.

In this process, both the organic and inorganic constituents are retained in the formulation. When the combustion starts, most of the organic biomolecules like proteins and long-chain carbohydrates (celluloses, lignin in plants, and glycogens in animal tissue) begin to break down into their respective monomeric units. Lipids also react to the heat by releasing their constituent fatty acids which in turn are converted into free radicals which speed up the breakdown of other biomolecules.

As the biomolecules begin to break down, their constituent atoms get released in the surrounding air in the forms of oxides of carbon, nitrogen, sulfur, etc and the typical, non-specific smell of combustion begins to spread. With time, a bulk of the mass of animal/plant tissue used gets reduced (the reduction depends on the type of method used to prepare the *mashi* and also on how accurately the procedure is followed). Towards the end of the heating, the powdery material begins to resemble carbon black or charcoal and is said to have a '*Sendriyatva*'. This quality essentially corresponds to the material/ash still having organic ingredients of interest. The organic ingredient in the *mashi* is also said to be in a slightly more activated state. Only thermostable ingredients stay back and heat-sensitive compounds decompose [18–20].

6. Standardization of *mashi*

A monograph of each *mashi* is required as it will help to standardize the *mashi*. Presently, no official data is available for the standardization of *mashi and* researchers are required to establish the parameters. The identity and purity of *mashi* can be done by following standardization parameters [34]:

1. Morphological evaluation: Colour, odour, and taste
2. Physical evaluation: Loss on drying, total ash value, acid insoluble ash value, water soluble ash value, extractive values and fluorescence study
3. Chemical evaluation: Preliminary phytochemical study, qualitative and quantitative analysis of inorganic radicals, determination of organic contents, Fourier Transform Infrared Spectroscopy (FTIR), Powder X-ray diffraction (PXRD), Differential Scanning Calorimetry (DSC), and Atomic Absorption Spectroscopy

7. Conclusion

The preliminary aim of this article was to clear the various misconceptions regarding the *mashi* formulation and provide clarity regarding its various available forms, the efficacy of their uses, and the prospects where more attention needs to be paid by researchers. Amongst animal source-based *mashi* formulations, *Mayurpiccha mashi* and *Kesh mashi* are the most widely used. A good amount of work is done on *Kesh mashi* and more work is required on *Mayurpiccha mashi*. The use of other *mashi* formulations made from animal sources, like *Hastidant mashi* is highly discouraged as it will more or less promote the poaching of the corresponding endangered animal species and greatly threatens biodiversity. Furthermore, no research work regarding the efficacy of the same is available. *Mashi* is a simple but very unique formulation. More research is required to identify the presence of constituents in *mashi*, isolation of constituents, and evaluation of its pharmacological activity.

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None.

Author contributions

Ameya Joshi: Writing- review and draft preparation, **Akshay Baheti:** Draft preparation and editing, **Manish Wani:** Data collection, **Ranjeet Nimbalkar:** Data collection.

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