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A Review Article On Sandhan Kalpana

Vd. Anuja Vijay Shinde, Vd. Dnyaneshwar Bhise
MD Scholar, Asst. Professor
Government Ayurved College, Dharashiv.

Abstract:

Sandhana Kalpana is an important pharmaceutical preparation method in Ayurveda based on the principle of fermentation. These formulations produce self-generated alcohol that acts as a preservative, extraction medium, and bioavailability enhancer for herbal drugs. Asava and Arishta are classical examples of Sandhana Kalpana, widely used in Ayurvedic therapeutics. This review discusses historical background, conceptual framework, classification, preparation methods, factors influencing fermentation, pharmacological aspects, quality control parameters, therapeutic applications, and contemporary scientific perspectives of Sandhana Kalpana. Sandhana preparations contain self-generated alcohol which acts as self preservatives having prolonged shelf life.

Keywords: Sandhana Kalpana, Asava, Arishta, Fermentation, Bhaishajya Kalpana.

Introduction:

Ayurveda deals with treatment of disease at the root cause, its prevention and cure. Ayurveda also helps in maintaining health and betterment of life. Rasashastra evam Bhaishajya Kalpana is a significant branch of Ayurveda where medicinal preparation takes place. Bhaishajya Kalpana mainly deals with herbal drugs. Bhaishajya Kalpana (Ayurvedic pharmaceutics) describes various dosage forms such as Swarasa, Kalka, Kashaya, Churna, Vati, Taila, Ghrita, and Sandhana Kalpana. Among these, Sandhana Kalpana is unique as it involves fermentation to produce liquid formulations containing self-generated alcohol. The Madhya sandhana contains both water soluble and alcohol-soluble active principles of the drug. They can be stored for a longer time without losing their therapeutic activity as the generated alcohol acts as a preservative too. The basic pharmaceutical principle in Sandhana Kalpana is to extract active constituents of drug through a biochemical process of fermentation in a mildly self generated alcoholic medium. This ensures extraction of both water- and alcohol-soluble constituents.(1)

Sandhana Kalpana is a unique dosage form which include every preparation that comes out of fermentation process. Asavarishta had a unique place among all Sandhana Kalpana. It is a self generated alcohol which facilitates longer shelf life, provides comparatively faster absorption, enhanced therapeutic efficacy and potency. It is also used as Anupana for various other medicines. In Sandhan Kalpana, drugs are processed through multiple steps and combined with various liquids like decoctions and juices, along with substances like jaggery and honey. The fermentation process enhances the stability, palatability, and clinical outcomes of the medicines, making Sandhan Kalpana unique and effective. From an etymological perspective, Sandhan means "mixing" or "combining." The process involves the exciting amalgamation of several ingredients to create exhilarating attributes through fermentation. It is a method of union and combination, where medicines are mixed and allowed to rest for a specific period to achieve fermentation.

Material & Method

Chronological appraisal of Sandhan Kalpana:

The fermentation method can be found chronologically in every phase of Indian civilization, that is, from the Vedic period to the present. In the past, testing of drugs during production and after they were finished

relied on subjective parameters, but in the present, the quality of finished drugs is evaluated using a variety of analytical and advanced biotechnological techniques (2).

Rig Veda: The Rig Vedic text of the ninth mandala has a significant section on fermented Soma Rasa. The topic includes around 610 verses. A special concoction known as Somarasa is a sweet liquid that is purported to be a result of the fermentation process. Along with Somarasa (Rigveda -2/14/01), the fermenting process was used to create Sura, another alcoholic beverage is described.

Kautilya Arthshastra: Separate chapters about Sura is mentioned. Some of fermented preparations are found like Medaka, Maireys, Prasana, Asava, Arishta, Madhu.

Atharva Veda: Clearly mentioned that madya which is used for the treatment purpose is known as arista and preparation process is mentioned as Abhishava Prakriya.

Ramayan: In Sudara kanda of Ramayana, a clear idea of a variety of Sandhana products prepared and ingested for intoxication purpose which stablishes the advanced stages of understanding and implementation of Sandhana Kalpana. The term Asava finds its first mention here, and moreover, Prasanna, Sura, Pushpasava, and Phalasava denote advancements in Sandhana Kalpana.

Charaka Samhita: 9 Yoni of Asava and 84 fermentative products are described. Acharya Charaka contributed six factors that are to be considered carefully before administration of any Madya as - Anna, Pana, Vayas, Vyadhi, Bala, and Kala.(3) It also describes the manufacture of fermented medications, including the definition of fermentation, requirements for the container, locations to keep the basic drugs, fermentation duration, and subjective criteria for testing the final product(4).

Sushruta Samhita: 21 Asavarishta and 46 Madya preparations including Madya, Sura, Prasanna, Jagala, Surasava, Madhvasava, Shukta, and Dhanyamla. are described. The addition of botanical ash to Asavarishta components can be attributed to Sushruta Samhita.

Ashtang Hridya and Ashtang Sangreha: In this time, the study of herbal medicine reached its height of development, as seen by the variety of Sandhana kalpanas that were created. Dhataki Pushpa (Woodfordia fruticosa) is used as a fermentation initiator for the first time in Ashtanga Hridaya together with other components(5). The container, the place, the period, and the criteria for assessing the result are all explicitly stated in numerous formulations, typically in line with earlier classics, demonstrating that physicians were well aware of the fermentation processes.The five ingredients identified to be utilised to make Madya and Sandhana kalpana are Draksha (grapes), Ikshu (sugar cane), Makshika (honey), Shali (rice), and Vrihi (grains)(6). A total of 17 Asava-Arishta in Ashtanga Sangraha and 8 in Ashtanga Hridaya are cited(7).

Kashyapa Samhita: Abhishava is mentioned as seventh fundamental Kalpana. Abhishava is a synonym of Sandhana Kalpana. In Part I, 6th chapter Asavadhikar, a total of 60 Asavarishtas are mentioned.

Sharangdhar Samhita: Definition, overall guidelines, precautions to take in the absence of precision, and several classifications depending on the source or raw material of fermentation are all included17. The most important contribution of this book is the establishment of a guideline for cooking Asava-Arishta when definite proportion of component are not given (8).

Yogaratnakara: Detailed description about Asava and Arishtas in Madya Kalpana is described.(9)

Bhaishajya Ratnavali: The text provides information about Sandhana formulation in a better way. Other than Asav-Arishta, Chukra, Sura, Shukta and Kanji is also mentioned. There are 50 Sandhana kalpanas cited in this book, of which 15 are Asava, 29 are Arishta, 2 are Chukra, 2 are Sura, 1 is Shukta, and 1 is a Kanji Kalpana.

Ayurvedic Formulary of India: 40 Asava-Arishta are fully described in Parts I and II of the Ayurvedic Formulary of India, including their pharmaceutics and therapies. The production method of Asava-Arishta is outlined at the beginning of each chapter in this book by the Department of AYUSH, Government of India, along with a systematic description of each formula's constituents and their proportions(10).

Classification of Sandhan Kalpana:

Sandhana can be categorised into two main groups based on the nature of the final product (11): Madya Kal pana, which refers to alcoholic preparations, and Shukta Kalpana. Madya Kalpana includes various subcategories, such as Sura-Prasanna, Kadambari, Jagala, Medaka, Surabija, Seedhu-Pakva, Apakva, Varuni, Asava, and Arishta. On the other hand, Shuk ta Kalpana encompasses preparations like Shukta, Tushodaka, Sauvira, Kanjika, and Sandaki.

Madya Vargiya Sandhan Kalpana(Alcoholic Preparations) (12)

Asava: Along with various herbal components and fermentation agents like as jaggery, honey, sugar, etc., a cold infusion, extracted juice, or plain water is taken in an earthenware jar. The vessel is then sealed and kept still in a neutral atmosphere. When ready, filter it and put it in glass containers for storage. In other words the alcoholic beverage produced without heating the drug in water (Dravapradhan) is Known as Asava. It enhances taste, lowers sleeplessness, boosts mental stamina, increases physical strength, and promotes happiness.

Arishta: An alcohol made from fermentation of Pakwaaushadha is called Arishta.[13] It is prepared by making decoction of drugs. It is mainly prepared with Ushna Virya Dravya. It is highly potent and generally used in adults and old age patients. Exception is Takraarishta. It acts as appetizer, Pittarodhaka, Kapha Vata Nashak, laxative and helpful in Grahni, Pandu Shosha, Arsha, Jwara, Grahni etc.

Sura: The fermented liquor prepared using cooked rice, barley, etc., is known as Sura. It is further classified as Prasanna - the clear supernatant fluid of Sura. Kadambari - slightly thicker than Prasanna. Jagala - Jagala is thicker and presents lower than Kadambari. Medaka - It is thicker to Jagala. Surabija - Residue left over after filtration is Vakkasa, Surabija, or Kinwa.

Sidhu: Sidhu is of two types - Apakwa (Shita) rasa Sidhu - Juice of sweet substances (like sugarcane juice) fermented without boiling. Pakwarasa Sidhu - Prepared by fermenting sweet juice after boiling them.

Varuni: The liquor prepared with the juice of Tala and Kharjura. It is lighter to Sura.

Prasanna: The clear supernatant fluid of Sura is known as Prasanna. It is thin upper layer of Sura. It is Ruchikar, Chardi Nashak and used in Anaah, Arsh, Gulma etc.

Kadambari: Slightly thicker layer than Prasanna is referred as Kadambari. It helps in digestion and useful in Anaah, Shoola. It is laxative in nature.

Jagal: Jagal refers to the thick portion below Kadambari (14). Alcohol is present in this part, although in lower concentration.

Medas: This layer lies beneath the jagal. It is significantly denser than the one above it and contains a very little amount of alcohol.

Vakkas or Suravija: Vakkas refers to the vessel's bottom layer. Alcohol is not present in this stratum(15). It can also be used as Fermenting agent therefore it is also known as Surabija.

Amla Vargiya Sandhan Kalpana (Acidic Formulations):

Shukta: Shukta is preparation, prepared by processing rhizomes, roots or fruits along with fat and salt. It is Laghu Ushna, Teekshna and helps indigestion. It causes Raktapitta but useful in Pandu Krimi. Fermentation media here are mainly carbohydrates and period of fermentation is usually within 15 days.

Kanji: This is a sour liquid prepared with fermentation of Manda of half boiled Kulmasha, Dhanya and other drugs like Shunthi, Haridra, Jeera etc. It acts as appetizer, alleviates Vata and Kapha. It is useful in Chardi, Jwara, Daha etc.

Tushoadaka: When Yava is coarsely powdered and mixed with suitable amount of water and kept for fermentation without any precooking. The liquid obtained is known as Tushoadaka. It is Deepana, Hrudya, and useful in Pandu, Krimi, Grahani, Arsh etc.

Sauveera: When fermentation of boiled Yava after removing its external covering is carried out. It is digestive, purgative and useful in Udavarta, Asthi Shola Grahani Arsha etc.

Sandaki: It is prepared by fermentation of leaves of Mulaka, Sharshapa, Saindhava Lavana etc. with eight times of water.

Chukra: When fermented liquor gets spoiled and loses its sweetness but become sour is known as Chukra.

List of Asava Yoni (source of fermentation products)(16)

Dhanyasava 6 - Sura, Sauvira, Tushodaka, Mairya, Medaka, Dhanyamla

Phalasava 26 - Draksha, Abhaya, Karkandu, Udumbara, Kharjura, Amalaki, Pilu, Ajamoda, Gambhari, Mrigalindika, Priyala, Shringataka, Dhanvana, Jambu, Panasa, Shankhini, Rajadana, Kapittha, Nyagrodha, Plaksha, Trunashunya, Kuvala, Ashvattha, Parushaka, Badara, Kapitana

Mulasava 11 - Vidarigandha, Shyama, Bilwa, Ashwagandha, Trivrit, Chitraka, Krishnagandha, Danti, Eranda, Shatavari, Dravanti

Sarasava 20 - Shala, Khadira, Arimeda, Shimshapa, Priyala, Kadara, Tinduka, Vanjula, Ashwakarna, Saptaparna, Kinihi, Dhanvana, Chadana, Arjuna, Shami, Madhuka, Syandana, Asana, Badara, Shirisha

Pushpasava 10 - Padma, Kumuda, Shatapatra, Dhataki, Utpala, Saugandhika, Madhuka, Nalina, Pundarika, Priyangu

Kandasava 4 - Ikshu, Kandekshu, Ikshuvalika, Pundraka

Patrasava 2 - Patola, Tadaka

Twagasava 4 - Tilvaka, Lodhra, Elavuluka, Kramuka

Sharkarasava 1 – Sharkarasava

Factors responsible for the accurate initiation of Sandhan Kalpana: -

♣ Temperature - There is a minimal amount of temperature variance at the process location where sandhana kalpana initiated. To fulfil this purpose in ancient times, containers for the preparation of Asava-Arishta were put in Dhanya Rashi, Bhugarbha, Chaulyagara, Koshthasara. With the help of this approach, the ideal temperature, direct avoidance of light and air, etc., were retained. In general, the ideal temperature needed to start fermentation is between 20 and 35 °C.

♣ Containers - All classical texts advocated the use of clay and wooden vessels for the fermentation process, but they have drawbacks since wooden containers need to be prepared and earthen pots are prone to breaking. Consequently, these pots were replaced by steel and plastic containers as pharmaceutics technology advanced. Studies were conducted to analyse the finished product physiochemically and organoleptically in order to answer the issue of whether it would be as effective with the particular kind of containers. It is determined that steel and plastic containers are suitable for Sandhana Kalpana.

♣ Duration - As stated in Sushruta Sutra Sthana 45/203 and Sushruta Chikitsa Sthana 12/12-17, the word "jatarasam" implies the conclusion of fermentation and production of the proper product. Fermentation times vary depending on formulation and can range from as short as seven days to as long as 180 days.

♣ Proportion of Carbohydrate - In Sandhana Kalpana products, carbohydrates serve as the primary source of nourishment. The kind and amount of carbohydrates present influence the rate of fermentation and the end product, such as biomass and primary and secondary metabolites, that are formed. The viscosity of a solution increases with an increase in the concentration of carbohydrates in the liquid. It has been noted by Acharya Charaka and Sharangadhara that the fermentation process in Sandhana kalpana uses 39.06% of sweet ingredients, often carbohydrates. But it is advisable to add just 40% of the sweet substances in order to start the simple and early fermentation; the remaining amount is added once the fermentation process has started.

General Pharmaceutical Procedures for the Preparation of Arishta Kalpana:

The preparation of Arishta Kalpana involves a series of steps that can be divided into three main categories: Poorva Karma, Pradhana Karma, and Paschat Karma.

Poorva Karma or preliminary procedures, includes the selection and preparation of the pot, known as Bhajana Samskara, which involves selecting the ap propriate container, or Sandhana Patra, and prepar ing it through Dhoopana and Lepana.

Pradhana Karma, or main procedures, encompasses several key steps, including the preparation of the ingredients, such as Drava Dravya, Madhura Dravya, Prakshepaka Dravya, and Sandhana Dravya, followed by filling and sealing the container, placing it in the appropriate location, and determining the duration of the Sandhana process. Paschat Karma, or subsequent procedures, involves observing the Sandhana process, filtering the final product, and storing it properly.

Poorva Karma:

After the selection of Patra for the enhancement of process and quality, Dhoopana, Lepana and Samskara Prakriya are performed. Before Lepana, the utensils are fumigated with different drugs such as Guggulu, Jatamansi, Agaru, Maricha, Karpura, etc. This process of Dhoopana prevents contamination, adds fragrance and increases the medicinal value of Sandhana Kalpana. Conventionally, a combination of Lodhra, Jatamansi and Ghrita Lepa is applied internally to the vessel before fermentation. This Samskara is mainly developed to complete the need to reduce the porosity of earthen pots and prevent the loss of Asavarishta. Lepana prevents the entry of oxygen into the Sandhana Patra; it also prevents con tamination and stabilises the temperature.

Pradhana Karma:

The pharmaceutical practices involved are Toya Sam skara, Agni Samskara, Desha Sannikarsha and Kala Sannikarsha. This is the most essential part of the fermentation reaction as it makes the source material of the fermentation fit for the action of the microor ganisms involved in this process. The complex poly saccharides or the starch are rendered digestible by the Agni and Toya Sannikarsha of microorganisms. The Agni Sannikarsha eliminates the contaminants. The primary method, known as Pradhana Karma, involves mixing four essential ingredients: Drava Dravya, Madhura Dravya, Sandhana Dravya, and Prakshepaka Dravya.

Paschat Karma:

These are observed in 3 phases as follows.

A) Observations at the initial stage: At the initial stage of fermentation, the Prakshepaka Dravya is observed to float on the surface of the liq uid, which appears thicker and sticky. Additionally, the temperature of the fermentation mixture remains relatively constant, showing little to no change.

B) Observations after the onset of fermentation: After the onset of fermentation, several notable changes occur: the Prakshepaka Dravya continues to float, and the liquid appears less viscous. The colour of Asavarishta darkens, and effervescence becomes visible, accompanied by a characteristic hissing sound emanating from the Sandhana Patra. A burning matchstick or candle will be extinguished when brought near the container. A mild alcoholic odour becomes apparent, and the lime water test yields a positive result. Furthermore, the temperature of the fermentation liquid is slightly elevated.

C) Observation after completion of the fermentation process: After the fermentation process, several distinct changes are observed: the Prakshepa Dravya sinks to the bottom of the container. A strong alcoholic odour becomes pronounced, and the audible sounds and effervescence cease. The temperature of the prepared Asava or Arishta decreases, and a burning candle continues to burn when introduced into the fermenting vessel. The lime water test shows no change, and other organoleptic parameters, such as the liquid's viscosity and alcoholic taste, are also notable.

Signs of onset and completion of fermentation:

No	Onset of fermentation	Completion of fermentation
1	Floating of prakshepa dravya over the liquid	Prakshepa Dravya will settle down
2	Hissing sound is present	Hissing sound is absent
3	Mild alcoholic odor and taste	Strong alcoholic odor and taste
4	Effervescence	No effervescence
5	Burning candle is put off.	Burning candle continues to burn.
6	Lime water turns milky white.	Test is negative. No change in lime water

Modern Approach Towards Fermentation: -

♣ Fermentation defined as a process by which production of product was done by mass culture of microorganisms. Fermentation in modern sciences mainly classified as follows-

1. Batch fermentation (closed system)

2. Fed-batch fermentation (closed system)

3. Continuous fermentation (open system). In batch fermentation, the sterilized nutrient solution inoculated with microorganism and allows proceeding in a fermenter. The growth during the fermentation observed in four phases and these are as follows: 1. Lag phase 2. Log phase 3. Stationary phase 4. Death phase. Fed-batch fermentation is the enhancement of the closed batch process in which all of the substrates are added at the beginning of the fermentation. In continuous fermentation, sterile nutrient solution is added to the bioreactor continuously mixed to homogeneous mixture and referred as chemostat and turbidostatic.

♣ Nutrient Requirement For microbial activity, microorganisms required several nutrients such as carbohydrates, lipids, purines and pyrimidines, vitamins and growth factors, amino acids, nitrogen sources, elements, and inorganic ions. Fermenter System It is divided into three phase systems which involve liquid-solid, gas-solid, and gas-liquid reactions.

♣ Gas Exchange and Mass Transfer- During operation in the fermenter, the provision of adequate gas exchanging is important. Oxygen is the most important gaseous substitute for microbial metabolism, and carbon dioxide is the most important gaseous metabolic product.

♣ Sterilization- Sterilization is one of the important processes during fermentation, and the sterilization of culture media, fermentation air, and fermentor is necessary.

♣ Fermentation process is completed in three stages: 1. Inoculum presentation 2. Inoculum buildup 3. Fermentor culture. Yeast metabolizes sugars, such as glucose and fructose, resulting in the formation of ethanol and carbon dioxide. Yeast influences the efficiency of conversion of sugar into ethanol. Selected strains isolated from honey and wine and commercial yeasts starter cultures have been studied. And honey is used in the mead production.

Discussion And Conclusion:

Ayurvedic medicine is poised to recover its once-famous status Because of its preventative and therapeutic properties, lack of side effects, and holistic approach. The renowned Ayurvedic formulations known as "sandhana kalpas" are frequently used for a variety of medicinal purposes. Classical references regarding Sandhana Kalpana are very prominent in all periods of Ayurvedic literature. Fermentation enhances the bioavailability and potency of the ingredients, making them more effective for therapeutic use. The dosage of Asavarishta is mentioned as 1 Pala (48ml) as per classical text but in daily practice it mainly depends upon the patient and the disease but generally, the dosage given is 15-30ml with equal amount of luke warm water twice a day in adults after meal.

This review is aimed at compiling some basic information which may further assist in strengthening the knowledge of academician and researcher those who are intersected in such dosage forms. Asava-Arishta is considered as the best formulation in Ayurveda because they possess better keeping quality, which is

likely due to the contribution of fermentation to preservation. Microbes mediate this process, and enhance therapeutic properties, which may be due to microbial biotransformation of the initial ingredients of Asava Arishta into more effective therapeutics as end-products, alcohol-aqueous milieu, which is also produced by microbes. Moreover, improvement in drug delivery in the body increases due to alcohol–aqueous milieu. Sandhana Kalpana represents a sophisticated pharmaceutical technique developed in Ayurveda. It combines herbal medicine with natural fermentation science to produce potent, stable, and palatable formulations. Integration of traditional knowledge with modern quality control ensures global acceptance of these preparations. Advantages of Sandhana Kalpana are - long shelf life, better patient compliance, faster absorption, lower dose requiremen , stable formulation etc.

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