

# Sandhana Kalpana: A progressive review

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## Abstract

Growing awareness about harmful adverse effects of allopathic medicine has led to interest in *Ayurveda* at the international level as well as within India. *Ayurveda* comprises of various types of formulations including fermented forms, namely, *Madya* and *Sukta*, *Sandhan kalpa*. *Sandhan kalpas* consist of unique and valuable therapeutic indications due to their efficacy and stability. It is prepared using decoction/*swarasa* of herbal drug and contains self-generated alcohol. Although these formulations are available in classical literature and used regularly, their scientific investigation and reporting is not widely available in literature for the acceptance of these formulations at global level, it is mandatory that scientifically sound concepts be presented for the formulation and quality control of these formulations.

**Key words:** *Ayurveda*, *Madya sandhan*, *Sandhan kalpa*, *Sukta sandhan*

## INTRODUCTION

**S***andhana Kalpana* as per the Ayurvedic system of medicine contains alcoholic and acidic contents in variable percentage produced by fermentation. These possess special properties which make them more beneficial than other preparations. 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.<sup>[1,2]</sup>

## CHRONICLED APPRAISAL OF SANDHANA KALPANA

The *Sandhana Kalpana* has been discussed from the Vedic period. Vedic literature gives a clear idea about the knowledge of *Sandhana*/fermentation, and it was highly advanced at that period. Chronological development of *Sandhana Kalpana* is given in Table 1.

## CLASSIFICATION OF SANDHANA KALPANA<sup>[8,11-14]</sup>

*Sandhana* is classified under two groups based on the nature of final product. Properties of these products are defined in Table 2 and their *Asava Yoni* (source of fermentation product) is given in Table 3.

## GENERAL PHARMACEUTICAL PROCEDURE UNDERLYING THE PREPARATION OF SANDHANA KALPANA<sup>[15-20]</sup>

The procedure used for the preparation of *Sandhana Kalpana* may vary and is given below:

1. *Purva-karma* - it includes selection of *Sandhana Patra* (fermenter), *Dhupana* (fumigation), *Lepana*, and collection of mentioned drugs.
2. *Pradhana-karma* - it includes *Drava Dravya* (preparation of liquid material), *Madhura Dravya*

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(sweetening agents), *Sandhana Dravya* (fermenting agent), *Prakshepa Dravya* (Adjuvants), *Purana* and *Sandhibandhana* of *sandhan patra* (filling and sealing of fermenter), *Sthanavimarsha* (placing of fermentor), and *Sandhana Kala* (fermentation period).

3. *Paschat-karma* - it includes *Sandhana Pariksha* (observations during fermentation process), filtration, maturation time, and storage.

## GENERAL METHODOLOGY<sup>[8,15]</sup>

The drugs mentioned in the classical texts are coarsely powdered and the suitable liquid is added. The prepared liquid mixture is transferred into the fermentation vessel and sugar, Jaggery or honey (where mentioned, should be added as such without being dissolved or boiled) are added according to the formula, dissolved, boiled, filtered, and added into prepared liquid material. Drugs mentioned as *prakshepa dravya* are finely powdered and added. Finally, *Sandhan dravya*, if included in the

**Table 1:** Chronological development of *Sandhana Kalpana*

Reference name	Content
<i>Rig-Veda</i>	A major part of the <i>Rig Vedic</i> text of the ninth mandala deals with fermented <i>Soma Rasa</i> . Nearly 610 verses are devoted to this topic
<i>Atharva veda</i>	Clearly mentioned that <i>madya</i> which is used for the treatment purpose is known as <i>arista</i> and preparation process is mentioned as <i>Abhishava prakriya</i>
<i>Yajur Veda</i>	Abundant citations describing various <i>Ahara Kalpanas</i> including <i>Sandhana Kalpana</i> are available in <i>Yajur veda</i>
<i>Ramayan</i>	In <i>Sudara kanda</i> of <i>Ramayana</i> , a clear idea of a variety of <i>Sandhana</i> products prepared and ingested for intoxication purpose which establishes the advanced stages of understanding and implementation of <i>Sandhana Kalpana</i> . The term <i>Asava</i> finds its first mention here, and moreover, <i>Prasanna</i> , <i>Sura</i> , <i>Pushpasava</i> , and <i>Phalasava</i> denote advancements in <i>Sandhana Kalpana</i>
<i>Mahabharata</i>	Use of <i>Madya</i> during war period is mentioned for the intoxication and relief from pain and also used for surgical practices
<i>Kautilya's Arthashastra</i>	Appointed a superintendent of spirituous liquors – " <i>Suradhyaksha</i> ," who was the controller of all the activities concerning the trade in the raw materials, fermenting wines, drinking stalls, and the price. Six types of <i>Sura</i> are quoted which were used commonly, namely, <i>Maireya</i> , <i>Prasanna</i> , <i>Asava</i> , <i>Arishta</i> , <i>Medaka</i> , and <i>Madhu</i>
<i>Charka Samhita</i> <sup>[3]</sup>	9 Yoni of <i>Asava</i> and 84 fermentative products are described. <i>Acharya Charaka</i> contributed six factors that are to be considered carefully before administration of any <i>Madya</i> as - <i>Anna</i> , <i>Pana</i> , <i>Vayas</i> , <i>Vyadhi</i> , <i>Bala</i> , and <i>Kala</i>
<i>Sushruta Samhita</i> <sup>[4]</sup>	<i>Acharya Sushruta</i> has to be credited to exploit <i>Sandhana Kalpana</i> in the purview of surgical practice. He described a total of 11 <i>Asava-Arishtas</i> and 46 <i>Madya Varga</i> - <i>Madya</i> , <i>Sura</i> , <i>Prasanna</i> , <i>Jagala</i> , <i>Surasava</i> , <i>Madhvasava</i> , <i>Shukta</i> , <i>Dhanyamla</i> , etc., serving various therapeutic purposes
<i>Ashtang Hridaya</i> and <i>Astanga Sangraha</i> <sup>[5,6]</sup>	Along with other ingredients, the use of <i>Dhataki Pushpa</i> as a fermentation initiator is documented for the first time in <i>Ashtanga Hridaya</i> gradation of the <i>Shukta Varga</i> products with respect to their <i>laghuta</i> is an innovative approach and a useful guideline to the practising physicians. A total of 14 <i>Asava-Arishta</i> in <i>Ashtanga Sangraha</i> and 8 in <i>Ashtanga Hridaya</i> are quoted
<i>Kashyapa Samhita</i> <sup>[7]</sup>	<i>Abhishava</i> included in seven fundamental <i>Kalpanas</i> . He was innovative in its approach for compilation of <i>Kalpanas</i> . In Part I, 6 <sup>th</sup> chapter <i>Asavadhikar</i> , a total of 60 <i>Asavarishtas</i> are mentioned
<i>Sharangadhara Samhita</i> <sup>[8]</sup>	Definition, general principles, measures to be adopted when specificity is unsaid, various classification based on the source/raw material of fermentation is mentioned
<i>Yogaratanakara</i> <sup>[9]</sup>	Detailed description about <i>Asava and Arishtas</i> in <i>Madya Kalpana</i> is described
<i>Bhiasihajya Ratnavali</i> <sup>[10]</sup>	Duration of time for fermentation is mentioned, i.e., 15 days or 1 month. A total of 50 <i>Sandhana Kalpanas</i> are quoted out, of which 15 are <i>Asava</i> , 29 <i>Arishta</i> , 2 <i>Chukra</i> , 2 <i>Sura</i> , 1 <i>Shukta</i> , and 1 <i>Kanji Kalpana</i>
The <i>Ayurvedic</i> Formulary of India <sup>[11]</sup>	In AFI Part I and Part II, a total of 40 <i>Asava arishta</i> are described

**Table 2:** Various types and properties of *Sandhana kalpa*

Group	Type	Definition	Properties and uses
Madaya Varga	Sura	The fermented liquor prepared using cooked rice, barley, etc., is known as <i>Sura</i> . It is further classified as <i>Prasanna</i> - the clear supernatant fluid of <i>Sura</i> . <i>Kadambari</i> - slightly thicker than <i>Prasanna</i> . <i>Jagala</i> - <i>Jagala</i> is thicker and presents lower than <i>Kadambari</i> . <i>Medaka</i> - It is thicker to <i>Jagala</i> . <i>Surabija</i> - Residue left over after filtration is <i>Vakkasa</i> , <i>Surabija</i> , or <i>Kinwa</i>	<i>Guru</i> (heavy), <i>Balya</i> (improve physical strength), <i>Meda</i> and <i>Kaphavardhaka</i> , <i>Shotha</i> (inflammation), <i>Gulma</i> (abdominal tumor), <i>Arsha</i> (piles), <i>Grahani</i> (malabsorption syndrome) and <i>Mutrakrichha</i> (dysuria)
	Sidhu	<i>Sidhu</i> is of two types - <i>Apakwa</i> ( <i>Shita</i> ) <i>rasa Sidhu</i> - Juice of sweet substances (like sugarcane juice) fermented without boiling. <i>Pakwarasa Sidhu</i> - Prepared by fermenting sweet juice after boiling them.	<i>Agni</i> , <i>Bala</i> , <i>Varnakrita</i> , <i>Hridya</i> (cardiac tonic), <i>Rochana</i> (improves taste), <i>Snehana</i> , <i>Vatpittakar</i> . <i>Vibandha</i> (constipation), <i>Arsha</i> (piles), <i>Udarshool</i> (pain in abdomen)
	Varuni	The liquor prepared with the juice of <i>Tala</i> and <i>Kharjura</i>	<i>Hridya</i> (cardiac tonic), <i>Laghu</i> (as compared to <i>Sura</i> ), <i>Shula</i> (pain), <i>Vibandha</i> (constipation), <i>Kasa</i> (cough), <i>Swasa</i> (dyspnea/asthama)
	Asava	The liquor prepared without boiling the drug in water ( <i>Dravapradhan Asava</i> )	Strengthening the body, beneficial to <i>Hridaya</i> , mitigates sleeplessness
	Arishta	The liquor prepared by "Pakwa-aushadham" that is boiled/cooked source material ( <i>Dravyapradhan Arista</i> )	G.I.T. disturbance, fever, diseases of spleen, appetizer, etc.,
Shukta Varga	Shukta	The product, which is prepared with roots, tubers, and fruits added with <i>Sneha</i> and <i>Lavana</i>	<i>Rakatapittakara</i> (bleeding disorder), <i>Kaphakledakara</i> <i>Vatanulomana</i> (relieves gastric distension)
	Tushodaka	Uncooked <i>Yava</i> is pounded along with <i>Tusha</i> ( <i>Satusha</i> ) and kept for <i>Sandhana</i>	<i>Pandu</i> (anemia), <i>Krimi rogahara</i> (antihelminthic), <i>Bastishulahara</i> (relieves urinary system pain)
	Souviraka	Fermentation of <i>Yava</i> , which is boiled after removing its husk ( <i>Nistusha</i> )	<i>Bhedana</i> , <i>Dipana</i> , <i>Arsha</i> (piles), <i>Kaphaghna</i> , <i>Grahani</i> (malabsorption syndrome), <i>Udavarta</i> (condition in which there is upward movement of <i>vayu</i> ), <i>Adhmana</i> (flatulence with gurgling sound), <i>Asthishula</i> (pain in bones)
	Kanjika	A fermented product prepared with <i>Manda</i> of half boiled <i>Kulmasha</i> , <i>Dhanya</i> , etc.	<i>Dahashamaka</i> , <i>Mukhavairasyahara</i> , <i>Mukhdourgandhyahara</i> (halitosis)
	Sandaki	A fermented product prepared with radish ( <i>Mulaka</i> ), mustard ( <i>Sarshapa</i> ), etc.	<i>Rocana</i> (improves taste), <i>Guru</i> (heavy), <i>Pitta-kaphahara</i>

formula should be properly cleaned before adding. The mouth of the vessel is sealed. The container is kept either in a special room or in an underground cellar or in a heap of paddy. The rate of fermentation depends on temperature, therefore as far as possible, temperature should be maintained constant during the fermentation procedure. After the specified period, the lid is removed, and the contents are examined to ascertain whether

the process of fermentation (*Sandhana*) has been completed or not. The fluid is first decanted and then strained after 2 or 3 days. When the fine suspended particles settle down, it is strained again and stored in well-stoppered bottles or jars.

If the fermentation is to be carried in an earthen vessel, it should not be new. Water should be boiled first in the vessel.

**Table 3:** List of *Asava Yoni* (source of fermentation products)<sup>[21]</sup>

Category	Total No.	Varieties
<i>Dhanyasava</i>	6	<i>Sura, Sauvira, Tushodaka, Mairya, Medaka, Dhanyamla</i>
<i>Phalasava</i>	26	<i>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</i>
<i>Mulasava</i>	11	<i>Vidarigandha, Shyama, Bilwa, Ashwagandha, Trivrit, Chitraka, Krishnagandha, Danti, Eranda, Shatavari, Dravanti</i>
<i>Sarasava</i>	20	<i>Shala, Khadira, Arimeda, Shimshapa, Priyala, Kadara, Tinduka, Vanjula, Ashwakarna, Saptapama, Kinihi, Dhanvana, Chadana, Arjuna, Shami, Madhuka, Syandana, Asana, Badara, Shirisha</i>
<i>Pushpasava</i>	10	<i>Padma, Kumuda, Shatapatra, Dhataki, Utpala, Saugandhika, Madhuka, Nalina, Pundarika, Priyangu</i>
<i>Kandasava</i>	4	<i>Ikshu, Kandekshu, Ikshuvalika, Pundraka</i>
<i>Patrasava</i>	2	<i>Patola, Tadaka</i>
<i>Twagasava</i>	4	<i>Tilvaka, Lodhra, Elavuluka, Kramuka</i>
<i>Sharkarasava</i>	1	<i>Sharkarasava</i>

**Table 4:** List of *Dhoopana Dravya* in *Sandhana Kalpana*<sup>[3,8,21,22]</sup>

<i>Dhoopan dravya</i>	Formulation	Reference
<i>Sharkara, Agaru</i>	<i>Kankarista</i>	<i>Ch. Chi. 16/168</i>
<i>Nambi, Maricha</i>	<i>Ushirasava</i>	<i>Sha. Sa. Ma. Kh. 10/13-17</i>
<i>Chandana, Agaru</i>	<i>Drakshasava</i>	<i>Ga. Ni. 6/160</i>

*Ch. Chi.* - Charaka Chikitsasthana, *Sha. Sa. Ma. Kh.* - Sharangdhara Samhita Madhyam Khand, *Ga. Ni.* - Gad Nigraha

Absolute cleanliness is required during the process. Each time, the inner surface of the fermentation vessel should be fumigated with *dhupan dravya* [Table 4] and smeared with *ghee* [Table 5] before the liquids are poured into containers [Table 6].

The filtered *Sandhana kalpana* should be clear without froth at the top. It should not become sour (*Cukra*) with time. The preparation has the characteristic aromatic alcoholic odor.

## MODERN APPROACH TOWARD FERMENTATION<sup>[27,28]</sup>

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 fermentor. 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 turbidostat.

### 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.

### Fermentor System

It is divided into a three phase systems which involve liquid-solid, gas-solid, and gas-liquid reactions.

**Table 5:** List of *Lepana Dravya* in the preparation of *Asavarista*<sup>[3,8,22]</sup>

<i>Lepana dravya</i>	Formulation	Reference
Pippali, Chavya, Madhu Priyangu, Ghrita	2 <sup>nd</sup> Phalarista	Ch. Chi. 15/153-157
Ela, Mrnal, Agar, Chandan	Madhukasava	Ch. Chi. 15/146-147
Pippali, Madhu	Loharistha	Su. Chi. 12/12-19
Lodhra, Dhatki	Dantyarista	Chakradatta Arsha/23-26
Maricha, Madhu	Gandirasava	Ga. Ni.

Ch. Chi. - Charaka Chikitsasthana, Su. Chi. - Sushruta Chikitsasthana, Sha. Sa. Ma. Kh. - Sharangdhara Samhita Madhyam Khand, Ga. Ni. - Gad Nigraha

**Table 6:** The use of specific containers used in different *Sandhana Kalpana*<sup>[8,23-26]</sup>

<i>Sandhan patra</i>	Formulation	Reference
Lauha Patra	Madhvasva	Ch. Chi. 7/73
Sandhana Patra made from stone	Kumariasava	Sha. Sa. Ma. Kh. 10/18-27
Earthen pot	Dashmula Arista	Sha. Sa. Ma. Kh. 10/77-91
Suvarna Patra	Sarswta Arista	B. R. 73/182 – 195

Ch. Chi. - Charaka Chikitsasthana, Sha. Sa. Ma. Kh. - Sharangdhara Samhita Madhyam Khand, B. R. - Bhaishajya Ratnavali

### Gas Exchange and Mass Transfer

During operation in the fermentor, 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.

act as an appetizer, their potential usefulness is enhanced. Due to various advantages such as palatability, quick action, convenience of administration, and longer shelf life, these preparations are preferred by the consumers. Classical references regarding *Sandhana Kalpana* are very prominent in all periods of *Ayurvedic* literature. The legacy has been carried by the contemporary practitioner of *Ayurvedic* medicine as well. In the ancient time, *sandhan patra* for preparation of *Sandhana kalpas* was placed in *Dhanya-rashi*, *Bhugarbha*, *Koshthasara*, etc., to avoid minimum temperature variation for facilitating as well as initiation of fermentation procedure. In modern science, the fermentation is growing vastly in the various fields such as biotechnology, pharmacy, and microbiology. Various new studies are conducted by the scholars on the fermentation concept, and the new procedures are finding to make it more beneficial and easy for use and production. Fermentation is a biological and biochemical process in which metabolic changes take place. Microorganisms are responsible for the fermentation changes in organic substances by enzymatic activity released in there surrounding. *Sandhana Kalpana* proves highly beneficial over other processes in Ayurveda as this process having medicinal as well as nutritional values. Biochemically, fermentation is incomplete oxidation. In the absence of molecular oxygen, microbes can switch to a pathway, wherein glucose is broken down into carbon dioxide and alcohol. 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.

## DISCUSSION AND CONCLUSION

Ayurvedic medication is all set to regain its lost fame because of its preventive and curative nature, less side effects, and holistic approach. *Sandhana kalpas* are the famous Ayurvedic formulations which are widely used for various therapeutic purposes. Moreover, as they have nutritive values as well as

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