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Review Article

Critical Review of Sandhana Kalpana

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ABSTRACT:

The *Sandhana Kalpana* (Biomedical Fermentation) is a unique dosage form of *Ayurveda. Sandhan Kalapana* has divided into 2 types i.e. *Madya Vargiya* (Alcoholic Fermentation) and *Shukta Vargiya* (Acidic Fermentation). These are self generated alcohol. These formulations are prompting many researchers to contribute to manufacturing quality control, safety and efficacy of these formulations, method of preparations, and various pharmaceutical and analytical parameters which mostly affect the preparation of *Sandhan Kalpana*. The shelf life of *Sandhana Kalpana* is said to be retained for many years. Although, amendments in Drugs and Cosmetics act 1940 and Rules 1945, mentions the shelf life of *Sandhana Kalpana* to be ten years. Method of preparation and various pharmaceutical and analytical parameters for *Asavarishta* are elaborated in this paper.

KEY WORDS: Sandhana, Sandhan Kalpana, Asava yoni, fermentation, HPTLC.

INTRODUCTION:

Sandhan Kalpana is a particular dosage form described in Ayurveda, which contains self generated alcohol. It facilitates longer shelf life, provides comparatively faster absorption and enhanced therapeutic efficacy and potency. In the etymological point of view, the term Sandhana implies the excited amalgamation of several ingredients for the process of alcoholic fermentation developing exhilarant attributes. A combination of different types of medicinal materials and their transformation make Sandhana Kalpana, a unique dosage form of Ayurveda.

DEFINITION:

Sandhana is the process in which liquids alone or along with medicines or food materials, are intermingled to produce *Madya* or such substances. In other words, Sandhana is defined as keeping the mixture of liquids like Kashayas, Swarasas, etc. and drugs or food substances like Guda, honey, etc. all together for a specific time period to facilitate the fermentation. The design protocol required to attain successful completion of the fermentation process, to meet chief desired characteristics and to secure maximum yield is termed as *Sandhana Kalpana.*¹ According to *Sharangdhara*, The shelf life of *Sandhana Kalpana* is said to be retained for many years.² although, amendments in Drugs and Cosmetics act 1940 and Rules 1945, mentions the shelf life of Sandhana Kalpana to be ten years.³

History of Sandhana Kalpana:

The *Sandhana Kalpana* has discussed from the Vedic period. Vedic literature gives a clear idea about the knowledge of *Sandhana* (fermentation).

Properties of Madya Kalpana: 5-9

Laghu, Ushna, Tikshna, Sukshma, Amla, Vyavayi, Ashu, Ruksha, Vikasi, Vishada. All types of Madyas are Pittajanaka, Amlarasayukta, Rochaka, Dipaka, Virechaka, Preenana, Brihana, Balya, Swaravarna Prasadaka, Bhaya-shoka-shramapaha, Kapha and VataNashaka, Hridya, Basti Vishodana, Indriya bodhanam. Navina Madya is said to be Abhishyanda, Guru, Vatprakopaka, Anishtagandhi, Virasa, Ahridya, Vidahi, Sheeta; whilePuran Madya is Sugandhi, Dipana, Hridya, Ruchikara, Kriminashaka, Strotoshodhaka, Lahu, Vrishya, Vata and KaphaNashaka.

Table No.1: Important literature regarding Sandhana Kalpana since Vedic period: 4

Reference name	Content		
Rig Veda	Soma Rasa is described by fermentation process.		
Atharvaveda	DescribedAbhishavaPrakriyaforArishtapreparation; used in treatment.		
Yajura Veda	Described various AaharaKalpanas including Sandhana Kalpana.		
Ramayan	DescribedAsava along with Prasanna, Sura, Pushpasava, and Phalasava, etc.		
Mahabharata	Madya was used during the war and surgical practices to relieve pain.		
Kautilya	Appointed "Suradhyaksha". Six types of Sura are quoted which were Maireya, Prasanna, Asava,		
Arthashastra	Arishta, Medaka, and Madhu.		
Charka	9 Asavayoni and 84 Asavas are described in Sutrasthana, and various Asavarishtas are described		
	in Chikitsasthana. Sura is said as "ShramaHaranamShreshtha".		
Sushruta,	Mentioned use of various fermentation products.		
Ashtangasangraha			
Ashtangahridaya	Used Dhataki Pushpa to initiate fermentation.		
Kashyapa Samhita	Abhishavaincluded seven fundamental Kalpanas which indicate Sandhan Kalpana.		
Sharangadhara	Sandhana Kalpana is described in detail.		
Yogaratnakara,	Mentioned use of various fermentation products.		
Bhaishajyaratnavali			
AFI	In AFI Part I, II, and III a total of 57 AsavaArishta are described.		

Chart No. 1: Classificification of Sandhana Kalpana



Sandhana Kalpana is classified under two groups based on the nature of the final product. These are outlined in Table 2.

 Fable No. 2:	Types of S	Sandhan K	(alpana: 10, 11	
				Î

Name	Definition	
Sura	The fermented liquor prepared using cooked rice, barley, etc. 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.	
	<i>Medaka</i> - It is thicker to <i>Jagala</i> .	
	Surabija- Residue leftover after filtration is Vakkasa, Surabija, or Kinwa	
Sidhu	Sidhu differentiates into two types -	
	Apakwa (Shita rasa) Sidhu - Juice of sweet substances (like sugarcane juice) fermented without boiling.	
	Pakwa Sidhu- Prepared by fermenting sweet juice after boiling them.	
Varuni	The liquor prepared with the juice of <i>Tala</i> and <i>Kharjura</i> .	
Asava	The liquor prepared without boiling the drug in water.	
Arishta	The liquor prepared by boiled/cooked source material.	
Shukta	The liquor prepared with roots, tubers, and fruits added with <i>Sneha</i> and <i>Lavana</i> .	
Tushodaka	Uncooked Yava is pounded along with Tusha and kept for Sandhana.	
Sauviraka	Fermentation of Yava, which is boiled after removing its husk (Nistusha).	
Kanjika	A fermented product prepared with boiled <i>Kulmasha</i> , <i>Dhanyamanda</i> , etc.	
Sandaki	A fermented product prepared with radish (Mulaka), mustard (Sarshana), etc.	

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Asavayoni: Nine Asava Yonis are described in Charaka Samhita. These are listed in Table No. 3. 12

Asavayoni	Total No.	Name		
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		
Sara Asava	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		

Table No. 3: List of Asavayoni

Asava and *Arishta Kalpana* are widely used in Ayurvedic practice. So, these are discussed in detail.

Asava Arishta Kalpana: 13

Asava and *Arishta* are medicinal preparations made by soaking the drugs, either in powder form or in the form of decoction (*Kashaya*), in a solution of sugar or jaggery, as the case may be, for a specified period of time, during which it undergoes a process of fermentation generating alcohol, thus facilitating the extraction of the active principles contained in the drugs. The generated alcohol served as preservatives.

Method of preparation:



Arishta:

The drugs mentioned in the text are coarsely powdered and *Kashaya* is prepared. The *Kashaya* is strained and kept in the formation pot, vessel or barrel. Sugar, jaggery or honey, according to formula, is dissolved, boiled, filtered and added. Drugs mentioned as *Prakshepa Dravyas* are finely powdered and added. In the end, dhataki pushpa, if included in the formula, should be properly cleaned and added. The mouth of the pot, vessel or barrel is covered with an earthen lid and the edges sealed with clay-smeared cloth wound in seven consecutive layers.

Asava:

The required quantity of water, to which jaggery or sugar as prescribed in the formula is added, is boiled and cooled. This is poured into the fermentation pot, vessel or barrel. Fine powders of the drugs mentioned in the formula are added. The container is covered with a lid and the edges are sealed with clay smeared cloth wound in seven consecutive layers.

Then *Asava* and *Arishta* containers are kept either in a special room, in an underground cellar or in a heap of paddy, so as to ensure that for the duration of fermentation, as far as possible, a constant temperature is maintained, since varying temperatures may impede or accelerate the fermentation. After the specified period, the lid is removed, and content examined to ascertain whether the process of fermentation (sandhana) has been completed. The fluid is first decanted and then strained after two or three days. When the fine suspended particles settle down, it is strained again and bottled.

Pharmaceutical process of preparation of *Pu Asava-Arishta*:

It can be divided into three stages:

- 1. **Purva karma:** Selection of Sandhan Patra, Dhupana, Lepana and collection of mentioned drugs.
- 2. **Pradhana karma:** It includes Drava Dravya (preparation of liquid material), Madhura Dravya, Prakshepa Dravya, Sandhan Patra, Sthanvimarsha, Sandhana Kala.
- 3. *Paschat karma*: It includes *Sandhan Pariksha*, filtration, storage, packing.

Purvakarma:

Selection of Sandhana Patra (vessels or containers): The vessel to be used for the fermentation process should be clean. Acharyas have mentioned various Patras to carry out the fermentation process, e.g. Lauha Patra (Cha.Chi.7/73), Stone or earthen pot (Sha.Sa.Ma.Kha.10/18-27). Lepana and Dhupana should be carried out with the prescribed drugs. Acharyas have suggested various Lepana and Dhupana drugs, which are outlined in table 4 and table 5.

Table No. 4: Dhupana Dravyas used	d in Sandhana Kalpana
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Dhoopan Dravya	Formulations	Reference
Sharkara ,Agaru	Kanakarishta	Ch.Chi.16/168
Jatamansi, Marich	Ushirasav	Sha.Sa.Ma.Khand 10/13-17
Chandana ,Agaru	Drakshasav	Ga.Ni.6/160

Table No.5: Lepana Dravyas used in the preparation of Sandhana Kalpana

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Lepana Dravya	Formulation	Reference
Pippali, Chavya, Madhu ,Priyangu, Gruta	Phalarishta	Cha.Chi.15/153-157
Ela,Mrunal, Agaru, Chandan	Madhukasava	Cha.Chi.15/146-147
Pippali, Madhu	Loharishta	Su.Chi. 12/12-19
Lodhra, Dhataki	Dantyarishta	ChakradattaArsha 23-26
Maricha , Madhu	Gandirasava	Ga.Ni.

Pradhankarma:

Aushadhi Dravya: This should be taken as per the formulation, especially in case of *Asavas*.

Drava Dravyas: The Drava Dravyas used for the preparation of Asavarishtas are Jala, Swarasa, Kwatha, Takra, Dadhi, Gomutra, Kanji, Dhanyamla, etc.

Madhura Dravyas: Guda, Sharkara, Phanita, Matsyandika, Honey, etc. are used.

Sandhana Dravya: These are the drugs which provide the inoculum for the fermentation to start. e.g. *Dhataki Pushpa, Madhuka Pushpa, Surabeeja, etc.*

Prakshepa Dravya: These are prescribed by *Acharyas* which flavor the product, and also have

precise therapeutic action.

According to *Sharangdhara*, if the quantity of ingredients for fermentation is not specified, one *Drona* (12.288L) *of Drava Dravyas*, and one *Tula* (4.8 kg) of jaggery should be taken. The quantity of honey should be half that of jaggery, while *Prakshepa* should be added one-tenth of the quantity of *Drava Dravya*.¹⁴

Sthanavimarsha:

After the addition of the *Sandhana Dravyas* the pot is closed with a lid, sealed with mud smeared cloth and kept undisturbed in a specified location for a specific period of time until chief desired characteristics are found. Table 6 shows the locations mentioned by *Acharyas* to keep the pot for fermentation.

Fable No.	8: locatio	ons to kee	p the po	t for ferr	nentation
			F - F -		

Location	Reference	
DhanyaRashi	Charak Samhita 15/160-165	
Bhugarabha, Kashtasara, Chaulyagara	Gadanigraha 6/1-14	
Ashwashala	Yoga Chintamani 4/22	

Pashchat Karma:

Fermentation should be checked for chief desired characteristics, then the liquid should be filtered and kept for a few days to allow the sediments to settle down at the bottom and again filtered to separate the sediments.

ADJIM, Apr - June 2020; Vol. 5 Issue 2

Chief desired characteristics:

- 1. *Prakshepa Dravy as* sink to the bottom.
- 2. Fermentation products possess alcoholic odor.
- 3. No sound heard and no effervescence is present.
- 4. The burning candle continues to burn if brought near the fermenting media.
- 5. No change is found in the lime water test.

Dose: *Sharandhara Samhita* has prescribed the dose of *Asava-Arishtas* as 1 Pala (48 ml).¹⁵ It should be given after proper examination of the patient.

Properties of Asava-Arishta:

• Asava:

Mana-Sharira-Jatharagni Bala Karaka, Nidranashaka, Shoka Nashaka, Aruchi Nashaka, Hridya.^{16,17}

• Arishta:

Deepan, Pachan, Rochaka, Kaphaj Vyadhi Nashaka, Shotha-Arsha-Grahani-Pandu-Aruchi-Jwara Nashaka.^{18,19}

Sr. No.Analytical testSr. No.Analytical test1Alcohol percentage6Viscosity2Sugar percentage7Thin layer chromatography (TLC)3pH value8Physical testing4Microbial study9Shelf life study	Table No. 9: List of analytical parameters for Asavarishta				
1Alcohol percentage6Viscosity2Sugar percentage7Thin layer chromatography (TLC)3pH value8Physical testing4Microbial study9Shelf life study	Sr. No.	Analytical test	Sr. No.	Analytical test	
2 Sugar percentage 7 Thin layer chromatography (TLC) 3 pH value 8 Physical testing 4 Microbial study 9 Shelf life study	1	Alcohol percentage	6	Viscosity	
3 pH value 8 Physical testing 4 Microbial study 9 Shelf life study	2	Sugar percentage	7	Thin layer chromatography (TLC)	
4 Microbial study 9 Shelf life study	3	pH value	8	Physical testing	
	4	Microbial study	9	Shelf life study	
5 Specific Gravity 10 HPTLC	5	Specific Gravity	10	HPTLC	

Analytical parameters for Asava Arishta:

Generally, Asava-Arishta as contain less than twelve percent of alcohol (most of them in a range of 3 to 6%).
Drugs and Cosmetics act 1940 and Rules 1945 defined the maximum packing size and maximum percentage of
alcohol which is shown in table 10 & 11.20

Table No. 10: Preparation with a high content of alcohol as a base

Name of the drug	Maximum size of packing
Karpuraasava	15 ml
Ahiphenasava	15 ml
Mrigamadasava	15 ml

Table No. 11: Preparations containing self generated alcohol

Name of the drug	Maximum content of alcohol	Maximum size of packing
Mritsanjivani	16%	30ml
Mahadrakshasava	16%	120ml

General precautions- If the fermentation is to be carried in an earthen vessel, it should not be new. Water should be boiled first in the vessel absolute cleanliness is required during the process. Each time, the inner surface of the fermentation vessel should be fumigated with *Pippali Churna* and smeared with *Ghee* before the liquids poured into it. The filter *Asava-Arishta* should be clear without froth at the top. It should not become sour. The preparation has the characteristics of aromatic alcoholic odour.²¹

Preservation-Asava and Arishtas can be kept indefinitely. They should be kept in well-stoppered bottles or jars.²¹

Fermentation in present scenario:²²

The fermentation process is carried out in a container called the fermentor or bioreactor. The design and nature of the ferment or vary depending upon the type of fermentation carried out. Invariably all the fomenters have facilities to measure some of the fermentation parameters like temperature, pressure, pH, elapsed fermentation time, liquid level, mass, etc.

The different types of fermenters are:

- 1. External recycle airlift fermentor—for producing bacterial biomass, with methanol as a substrate.
- 2. Internal recycle airlift fermentor—for producing yeast with oil as substrate.
- 3. Tubular tower fermentor—used for making beer, wine, vinegar etc.
- 4. Nathan fermentor—used in the brewing industry.
- 5. Stirred fermentor—used for making antibiotics.

Types of Fermentation Processes:

There are three different processes of fermentation viz.:

Batch fermentation:

This term is attributed to that type of fermentation wherein there is a change in the culture medium, a number of microorganisms and the amount of the product produced (i.e. the metabolite or target protein). In batch fermentation, six phases of the microbial growth are seen.

- a. Lag phase
- b. Acceleration phase
- c. Log phase
- d. Deceleration phase
- e. Stationary phase
- f. Death phase

Feb-batch fermentation:

In this type of fermentation, freshly prepared culture media is added at regular intervals without removing the culture fluid. This increases the volume of the fermentation culture. This type of fermentation is used for production of proteins from recombinant microorganisms.

Continuous fermentation:

In this type of fermentation the products are removed continuously along with the cells and the same is replenished with the cell girth and addition of fresh culture media. This results in a steady or constant volume of the contents of the fermenter. This type of fermentation is used for the production of single cell protein (S.S.P), antibiotics and organic solvents

Procedure of Fermentation:

- a. Depending upon the type of product required, a particular bioreactor is selected.
- b. A suitable substrate in liquid media is added at a specific temperature, pH and then diluted.
- c. The organism (microbe, animal/plant cell, sub-cellular organelle or enzyme) is added to it.
- d. Then it is incubated at a specific temperature for the specified time.
- e. The incubation may either be aerobic or anaerobic.
- f. After the specified time interval, the products are removed, as some of the products are toxic to the growing cell or at least inhibitory to their growth. The organisms are re-circulated. The process of removal of the products is called downstream processing.

The chemical equations below summarize the fermentation of sucrose $(C_{12}H_{22}O_{11})$ into ethanol

 (C_2H_5OH) . Alcoholic fermentation converts one mole of glucose into two moles of ethanol and two moles of carbon dioxide, producing two moles of ATP in the process. The overall chemical formula for alcoholic fermentation is:

$C_6H_{12}O_6 \rightarrow 2 C_2H_5OH + 2 CO_2^{23}$

Undesirable sugars are removed from the plant materials by a fermentation process and make the product more bio-availability by eliminating side effects such as gas and bloating. In fermentation process increases alcohol level and it extracts a wide range of active ingredients from the herb than any other method of extraction. Fermentation not only removes the contamination but also reduce the toxicity of some toxic components in plants. Herb cells are ruptured by the Fermentation process and exposed openly to the menstruum where the cell wall is broken down by bacterial enzyme which further assists in the leaching process. The fermentation process the constituents from the herbal material to the menstruum.^{24,25}

DISCUSSION:

Sandhana Kalpana is a unique Ayurvedic dosage form which is widely used for various therapeutic purposes, due to its various advantages such as potency, palatability, quick action, the convenience of administration, and longer shelf life. In Sandhan Kalpana, Sandhanadravya provides the inoculums to start the fermentation. The process of fermentation necessitates the presence of fermenting micro-organisms known as yeasts. Dhataki Pushpa was introduced for the first time by Acharya Vagbhata in many Arishta and Asavas for stimulating the fermentation process. Madhuka Pushpa, Surabeeja, Kinwa, etc. were also used to initiate the process of fermentation. The yeasts multiply rapidly in the number of divisions in a short time. The Prakshepa Dravyas, flavor the medicine and also have their pharmacological actions too. Fine powders of Bhasma or metallic preparations are added to provide specific therapeutic attributes to the Asava-Arishta. The minimum percentage of sweetening substances recommended in Asavarishta is 20%, while the maximum percentage is up to 40%.

In modern science, the fermentation is growing vastly in the various fields such as biotechnology, pharmacy, and microbiology. In *Asavarishta*, microbial transformation helps in initiating the process of generating alcohol to extract the therapeutic attributes of a group of natural ingredients and

ADJIM, Apr - June 2020; Vol. 5 Issue 2

enhance its bioavailability. The hydro-alcoholic extraction of phytoconstituents from the herb shows improvement in drug delivery in the body of the consumer. Biotransformation in the formulation is mediated by native microbes, which potentiate the drug and preserves the formulation.

Asava-arishta dosage form helps the collective transformation of multiple phytochemicals having therapeutic attributes present in a group of raw ingredients to provide safe, potent and easy to administer liquid form with prolonged shelf life. Various new studies are conducted by the scholars on the fermentation concept, and make it more beneficial and easy for use as a medicinal drug and more convenient to production in pharmacy. 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 to be highly beneficial over other dosage forms in Ayurveda as this process is having medicinal as well as nutritional values. Nowadays standardization is necessary for the manufacturing of Asavarishtas.^{26,27}

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