Quality Control in Ayurved and Its Interpretation

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Abstract

Quality, the denominator of any object for its acceptance is the prime issue in present scenario. It is also applicable for the drugs of different origin mentioned in Ayurveda. Ayurvedic science has developed in a cultural milieu and through a methodology that is based on a subjective approach to standardization. After scrutinizing the classics, it can be said that the ancient seers were well familiar with the concepts of quality control of the drugs, which helps in maintaining positive health and eradicating diseases, while the contemporary system learnt about the significance, in recent times only. WHO too starts to think about implementation of quality control aspects for herbal drugs in recent past. This paper reflects some light on the important subjective quality control parameters mentioned in classics along with some advanced analytical and phytochemical investigations for the quality control, along with suitable examples based on recent studies. Attempt has also been made to compile the scattered references pertaining to quality control from the ancient classics along with justification at few instances. The whole paper tries to reflect a need of collaborative approach between ayurvedic and modern sciences for better understanding and to create relevant quality standards.

Key words

Ayurvedic medicines, commercialization, quality control, raw material, finished products.

Introduction

Success of any healthcare system depends on the availability, authenticity and safety levels of suitable drugs. In nut shell, one can say that all healthcare services will get paralyzed without having safe / potent drugs. Considering the significance of this view, authenticity, purity and quality of the medicinal substances have been emphasized through ages. A verse of Charaka speaks clearly about this, mentioning "An improperly treated drug would kill an individual like a thunderbolt"[1].

The word 'Quality' denotes the "degree of excellence"[2] or says "degree to which a set of inherent characteristic fulfills requirements"[3]. It is an important factor dealt for any of the substance present in this universe. In relation to dosage forms this term denotes towards potency, purity, stability & efficacy etc. The quality of any dosage form should not only be tested at the final stage; but the measures should be adopted right from the stage of procurement of raw materials through processing until it reaches to the consumer[4].

The Ayurvedic system of medicine, introduced as early as the dawn of human civilization, embraces with in its folds the drugs of plant, mineral and animal origin used as single as well as in compound formulations[5]. During the initial days of pharmaceutical development, the sector was limited to the physician's kitchen and ancient physicians used to collect the raw materials after proper identification and authentication of genuine quality on the basis of various ayurvedic parameters like Prakriti (nature), Guna (pharmacognostic characteristic/quality), Prabhava (specific pharmacological activity) as well as place, season and method of collection etc. Most of these are even also followed nowadays; the only difference is the method of evaluation which was primarily subjective during ancient period while objective today. All these makes clear that, the ancient physicians were well versed in identifying single drugs, their preservation; pharmaceutical processing along with their

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therapeutic dose and logical uses etc[6]. The basic qualities of a raw drug, required for medicinal purpose, are also described in Charaka Sutra Sthana in a Sanskrit quotation, which indicates towards suitability of the drug at pharmacognostical, pharmaceutical and pharmacological parameters. It include abundant availability, good therapeutic value, capable of being compounded in to various dosage forms through different pharmaceutical processings and should be in excellent condition i.e. without any infestation, contamination, adulteration, presence of foreign material etc., with required Rasa (taste), Guna (character / quality) and Virya (potency) etc[7].

The term "Sampat" of the verse indicates the quality standards of the drug, which is the most essential aspect during selection and procurement of raw material and will cover the following aspects:

1) Organo-leptic evaluation

2) Physico-chemical evaluation

3) Microbial contamination, pesticide residues and estimation of heavy metal contents etc.

Several classical references are available regarding the precautionary measures taken right from the procurement of raw materials; where as Siddhi Lakshanas (finished product characteristics) are given for in process quality control.

Quality control in Ayurveda

Ayurvedic formulations have also their quality parameters as described in various classics in scattered manner. These can be arranged in following three headings for better understanding.

A. Raw drug quality control

B. In process quality control

C. Finished product quality control

A. Raw drug quality control (Collection / Harvesting / Processing of Medicinal plants):

Procurement of genuine raw materials is one of the indispensable steps during preparation of a quality product. Any shortcomings during collection of raw material, like grown in contaminated soil, collected in immature/ infested condition or during improper season etc, have direct effect on the potency of the raw materials and ultimately on the finished products. Various points mentioned by Acharya Charaka with reference in this area needs to be examined before administering any of the drug[6]. Some of the important points which should be keenly checked for the procurement of raw materials as described in classics are dealt here under.

Description of place (Habitat)

Before forwarding towards the collection of any herb, it is needed to analyze the quality of the soil and environment of the place of collection, as the therapeutic attributes of the drugs depends upon them. The quality of soil or place for the procurement of herbs (Table 1), places from where drugs should not be collected (Table 2) etc. points are exclusively focused in ancient classics[8,9,10]. On the other hand Acharya Sushruta has described that the predominance of specific Panchabhautika property (phytoconstituents) possess by the drug also depend on the qualities of area from where it was collected[11]. Acharya Sharangadhara also quotes that the herbs belonging to Himalayan region are having Saumya properties, which produces anabolic changes where as those belongs to Vindhya region are having Agneya properties which depicts catabolic activities[12].

Description about place, given in ayurvedic texts indicates towards the habitat, nature and colour of soil indicating towards the mineral contents of the soil which is directly related with the therapeutic actions of the drug. Contamination of soil with heavy metals, pollutants, industrial byproducts etc. ultimately affects the plant and leading to defects in quality. Controversy over the plants under the list GRAS is a recent example, which is an outcome due to negligence of soil quality and habitat. Thus soil examination becomes one of the necessary steps during procurement of herbs.

Acceptable qualities of raw materials[13,14,15]

Besides examining the place of collection, Acharyas have also provided detailed descriptions regarding the acceptable qualities of the drugs for therapeutic purpose (Table 3). The mentioned subjective parameters reflect towards the acceptable physico-chemical &

phytochemical information regarding the drugs.

Time of collection

The drugs become accomplished to generate maximum therapeutic effects if their potency is augmented by Desha - Sampat (collected from appropriate habitat) and Kala - Sampat (collected at appropriate time)[8]. Almost all the drugs are mentioned to be collected in the early morning[16]. Acharya Charaka and Vagbhatta have almost same opinion about the specificity of season for the collection of different parts of a plant (Table 4)[13,17]. While Acharya Sushruta opines that the drug having Saumya Guna (anabolic characters) should be collected during Saumya Ritu (winter or spring season) while the drug having Agneya Guna (catabolic characters) should be collected during Agneya Ritu (summer or rainy season)[18]. As per Acharya Sharangdhar, for all the purpose drugs should be collected during Sharada ritu (late rainy season) while for vamana and virechana karma, drugs should be collected at the end of spring season[19]. Latter classics followed the same concepts with a slight modification in Raja Nighantu[20].

The synonyms or features of raw drugs cited in ayurvedic texts are suggestive for their proper identification. Drugs, deteriorated by environmental, mechanical or biological factors, should not be adopted for medicinal purpose. Seasonal specifications are also mentioned for the collection of various parts of a plant. Scientific studies prove the variation in the alkaloid percentage of Vasa collected in different months of a year (Table 5)[21]. The alkaloid contents in the leaves of Vasa are at peak in the month of August, September and October, similarly variation in total solid content of Vasa swarasa was also reported (Table 6)[22].

Utilization of genuine parts of a drug

Part used of a drug for the preparation of a formulation plays an important role about its efficacy. A study on Shirisharishta also shows that utilization of different parts of the drug, directly affects the therapeutic properties of the finished products. In the study, Shirisharishta was prepared by utilizing three different parts i.e. bark, sapwood and heartwood of Shirisha (Albizia lebbeck Benth.). HPLC study shows that the main chemical constituent of the drug i.e. epigllocatechin gallate is found in maximum concentration in the bark than that of heartwood, but contrary to it, the concentration of the same is found higher in heartwood based formulation than that of bark[23]. This may be the reason why twak (bark) of Shirisha is commonly mentioned for the preparation of Churna kalpana[24] or Ghrita[25] etc. while for the preparation of Asava-arishta, sara (heartwood) is indicated as Asava-yoni[26]. Here the Asava-yoni term is given on the basis of the best used part, suitable for the preparation of Asava-Arishta etc type of ayurvedic fermented dosage forms.

Storage of raw material[27]

As most of the raw materials are not available throughout the year in abundance and are seasonal crops. Also some of the drugs can be procured only from a region specific e.g. Hingu, Ela, Dhataki, Nagkeshar etc Therefore these drugs should be collected from their available source and favorable season. For the purpose of their availability through out year, these should be stored appropriately after proper processing to avoid their deterioration. The factors like temperature, moisture, dust, insects etc. are the responsible for deterioration of a raw drug.

In classical texts, these are mentioned to be stored after proper harvesting in appropriate containers; well covered with a lid and hung on a swing. The store room should be resistant to wind or storm however having appropriate ventilation. Adequate storage of the raw materials or finished products is the matter of immense attention. Specific types of containers are required for the storage depending upon their specific physico-chemical properties, so that these can be protected by various factors like environmental, mechanical or biological hazards. Daily flower-offerings and sacrificial rituals are also indicated in the store room, which indicates that daily entry of personnel is must, so one can observe the condition of the stored material. The rituals may be used for the avoiding the invasion of contaminating micro-organisms in the room.

In process quality control

Ayurvedic pharmaceutics comprise of a variety of formulations which are selected according to the nature of the disease, condition of the patients and also the qualities and

availability of the drugs[28]. Several formulations have their own rules of preparations and their quality control measures thoroughly dealt in various classical texts. Some important measures for the preparation of ayurvedic formulations are discussed here.

Kwatha kalpana

Particle size of raw drug, amount of water taken and its reduction by heating, quantum of heat required etc. are the major factors during its preparation. Aacharya Charaka has described that raw drug should be cut into small pieces (Khandschhedaitva), continuous stirring is needed (Satatamavaghatayan). Although a lot of variations are found related to quantity of water taken and the extent up to which its volume should be reduced, one general principle mentioned by Charaka is supposed to be most suitable characteristic i.e. "Gata-rasatvam" stage, which means the Rasa (taste) of the raw materials should be transferred to the decoction[29]. The quantum of heat required for preparation should be termed as mild (mridu)[30].

Lesser the size of raw material better will be the extraction, the concept was also considered during Kwatha preparation i.e. the particle should be up to finer stage. This is also supported by "mass transfer theory" that maximum surface area is needed for better extraction. It must be emphassised that the greatest degree of size reduction is not necessarily to be preferred. Thus it has been shown experimentally that, if dry extracts are made from drugs such as belladonna or stramonium, it is possible to obtain a greater total extractive when a finer grade of powder are used, but that the extract from a moderately coarse powder contains a higher proportion of alkaloid. Mild heat or / along with reduced pressure is also recommended for the extraction process. As per study it is observed that application of more than 60°C temperature for longer time may leads to destruction of alkaloids present in the drug by hydrolysis[31].

Churna kalpana

In the classical references for Churna preparation, herbs should be dried in shade, pounded well with an instrument made up of stone and to be filtered through a clean cloth. The drug should be reduced to such a level as the particles seen in the sun rays comes through the window in a dark room[32,33]. The recommended size of Churna also, indicated for its better absorption or easy extraction of its phytocnstituents during metabolism as per the "mass transfer theory".

Avaleha Kalpana

Avaleha siddhi lakshana[34,35,36] ensure, not only different stages of pharmaceutical procedure but also quality of the final product. Overall it may be simplified into following two stages- Asannapakva Avastha & Supakva Avastha.

Asannapakva Avastha Lakshna

These features indicate towards the concentration of sweet substances (jaggery/ sugar) in liquid material, which directly influences the final form of the medicament. In short, these mark the stage to stop heating and add Prakshepa Dravya (adjuvants) (Table 7).

Supakva Avastha Lakshana

These signs indicate organoleptic characters (Table 8) of the final form of "Leha" after addition of Prakshep Dravya (adjuvants), Sneha (fat/oil) and Madhu (honey) etc. Ayurvedic parameters denotes towards attainment of a specific physical form of the finished product for quality maintenance.

Signs given in Table 7 & 8 are indicative of extent of sugar percentage as well as the achievement of the final characteristics of finished product and both of these are important factors regarding quality maintenance of Avaleha kalpana. As more as paka (heating) of sugar solution proceeds; the water content decreases accordingly.

Sneha Kalpana

Method of Sneha Kalpana preparation is dealt by various Acharyas[37,38,39]. The presence of moisture content in the Sneha (oil) and Kalka (paste) condition of the drug are the indicative of Sneha Paka stages[40,41,42,43] (Table 9). Sneha Siddhi awastha[37,42,44,45] i.e. completion stage can be decided by examining the presence of specific characters in the Sneha and Kalka Dravya as given below-

For Sneha:Shabdasya Uparame Prapte. .....Gandha-Varna-Rasadinam Samyato

The appearance of desired smell, colour and

taste of added drug in the oil along with subsidence of the bubbling sound from the oils, are the deciding parameters for the completion of Sneha Paka. An indicative measure is also described for the examination of completion test during Ghrita / Taila kalpana preparation as Phenasya Uparame (subsidence of frothing) and Pheno Atimatram (augmentation of frothing) respectively[44].

For Kalka: Nanguli grahika Kalke, na snehe agnau shabdata

The stage when Kalka seems as to be non sticky and can be easily molded into Varti (spindle) form by rolling it between fingers and no cracking sound appear on fire etc are the indicatives of extent of moisture content in the Kalka, which are reduced after attainment of the Siddhi awastha[46].

Besides these, some classical text of 18th century are also put emphasis on the Murchhana of the oils for the removal of Ama dosha and for augmentation of the medicinal properties of the medicinal Taila/Ghrita. Here, Ama dosha may be considered as unwanted component among the raw oils/ghrita; like intermediate chemical constituents, dissolved gasses, adulterants, plant toxins and/or moisture present in raw oils or developed due to long time storage. Murchchhana process may be introduced during theses period for the removal of these unwanted materials i.e. Ama dosha. The process may also helps in maintaining the necessary ratio of unsaturated and saturated fats suitable for human physiology[47].

Pharmaceutically three stages of Sneha paka, are mentioned in Ayurvedic classic on the basis of therapeutic point of view viz. Mridu paka (mild cooked), Madhyam paka (sufficient/ medium cooked) and Kharapaka (excessive cooked). The Mridupaka is indicative of moisture presence in the Kalka (paste) of herbal drugs used for preparation and is diagnosed physically by touch and molding into spindle shape (Varti); it seems to be sticky in nature. In the Madhyam paka, no moisture presence remained in Kalka and can be easily molded into spindle shape, but in Kharapaka, inflexibility appeared in the Kalka. Sneha Siddhi Lakshana like "Shabdasya uparame prapte" suggests reduction of water i.e. extent of moisture content. When water remains present in the oil it produces the hissing sound and this sound disappears gradually after reduction of water. "Gandhavarna rasadinam sampatau" suggest that desired active constituents are transferred into the oleaginous media. 'Phenashanti' and 'Viphena parichapalagata', specifically for Ghrita suggest that there is no production of any gases resultant into absence of frothing[37,42,44,45].

Sandhan Kalpana- Sandhan Kalpana is one of the most advanced and complex classical ayurvedic formulations. Ancient scholars mentioned several precautionary measures based on their experience for maintaining genuine quality of a fermented product like specific Asava yoni (part used) of drugs, type of Sandhan patra (fermentation vessel), nature and concentration of nutrient medium / sweetening agent, Prakshepa dravya (adjuvants), place and duration of fermentation along with seasonal effects etc. These all may be intended for acquiring specific product components which would be beneficial for curing the diseases for which the Asava are recommended. As per the modern fermentation technologist, a variety of primary and secondary metabolites are produced due to the activity of specific micro-organisms during fermentation process. A specific micro-organism is required for obtaining specific intermediate / end product. Nowadays modern pharmacies adopts some developed artificial fermentation techniques for the production of specific antibiotics, antiseptics etc by using some specific micro-organisms. But these all measures are limited to single micro-organism and/or for the production of a single compound while the ayurvedic fermentation technique is seems to be based on multy-organism activity for the production of a group of intermediate / end products some what like wild fermentation. Therefore the standardization of these ayurvedic dosage form is seems to be a tedious job without prior knowledge of the each and every components and steps of the ayurvedic fermentation technique.

Asava yoni (official parts of drugs used for fermentation)

Total nine Asava yonis are mentioned by

Acharya Charaka including 84 Asava dravyas (drugs used for fermentation) as the official part of the drug for Sandhan (fermentation). As per example it is already discussed that Shirisharishta prepared by heartwood of Shirisha shows better result on all the grounds i.e. pharmaceutical, analytical, pharmacological as well as on clinical study than that of the bark or sapwood based formulations. It clearly indicates towards the significance of Asava yoni mentioned in Charaka Samhita. In the same reference Dhataki (Woodfordia fruticosa Kurz) is also found described in Phushpa yoni (flower group) that's why in later texts its flower is commonly used for preparing various types of Asava-arishtas[26].

Sandhan patra (fermentation vessel): Specific vessel is mentioned to be used for the production of specific product like Madhvasava, Kumaryasava, Saraswatarishta etc[48,49,50,]. Some of the traditional vessels mentioned in the classics are enlisted as – earthen, wooden and metallic vessels etc. Nowadays food grade plastic & steel vessels are commonly used for the fermentation instead of these. These all are the result of time to time modification adopted for further ease in the process and enhancement in the quality. One of the study carried out by Hiramath S.G. et al conclude that porcelain, steel and plastic containers are better alternatives to earthen containers[51].

Patra Sansakar (preparation and sterilization of vessels) is also indicated in sequential manner as Prakshalan (washing), Dhoopan (fumigation) and Lepana (coating/oleation)[52]. These traditional processes are needed to prevent contamination and facilitate the fermentation in the earthen pots. Lepana may be adopted for closing the minute pores of the earthen pots along with providing a nutritive media to desirable microorganisms.

Madhura Dravya (Nutrient medium / sweetening agents): Acharyas have also utilized sweetening agents mentioned in Ikshu or Madhu varga as a nutritive media for fermenting microorganism. As per modern view maximum limit of sugar concentration required to facilitate fermentation is 15-40%, while in ayurvedic fermented products concentration of sweetening agent (jaggery) is observed to be up to 150%[53] and still a successful fermentation is observed. The mere purpose of such types of variations regarding variety of sweetening agents as well as the amount is not only for providing nutritive media but also to facilitate specific microorganism to work out.

Temperature factor for addition of sweetening agents: Temperature of the medium before addition of sweetening agent is also a matter of great concern for facilitating fermentation. In classical literatures the term Susheetam / sheeta are mentioned denoting the temperature of medium i.e. the herbal decoction should be properly cooled up to room temperature[54,55] before addition of sweetening agents. It is a general fact that at higher temperature the sugar leads to hydrolysis which is useless to the organisms, which was also considered by ancient Acharyas.

Prakshepa dravya (adjutants): A variety of adjuvants are found described during preparation of Asava-arishta. Most of these are aromatic in nature. These not only provide essential nitrogenous source to the media for regulating the fermentation reaction but also have medicinal importance to augment the effect of main drug besides contributing pleasant colour, taste and aroma to the Asava-arishta.

Place and duration of fermentation: Regarding place Acharya Charaka has mentioned that it should be kept in Dhanya / Yava rashi (between the rice/barly husk)[56,57] whereas other references are also found regarding place of fermentation as Bhugharbha (under ground)[55], Vaihayasda (open sky)[58] too. Duration of fermentation also varies on the basis of type/ concentration of sweetening substances used or place and season of preparation. The duration taken for fermentation in cold atmosphere is double than that in warm atmosphere[59,60]. As per modern studies the most favorable atmospheric temperature for fermentation is in between 30-36°C.

Determination of fermentation: As no clear references are found regarding the completion signs of the sandhan kalpana in classics except the term used as 'Jatarasam'[61]. Few characteristic signs developed by imminent scholars as tradition for the determination of onset and completion of fermentation (Table 10) but these

are not mentioned in classical texts. The bubbles coming out from the bottom are indicative of fermentation process. Alcoholic aroma indicates presence of alcohol (C_2H_5OH) in the preparation.

Finished product

The quality of finished product is determined by appearance of desirable characters like smell, colour and taste etc (Istagandha varna rasotpatti). Besides these a quality medicine should be more therapeutically more potent even in low dose, easily eliminate most of the doshas (disease causing factors), easily digestible, palatable and should pacify the disease without producing any side effect when administered in therapeutic dose[62]. The appearance of desired color, taste, smell and consistency suggest that the properties of raw material has now come in the product and this can also be confirmed by the technologies like TLC, HPTLC, HPLC, GC, NMR etc. Various studies are carried out nowadays considering these advance technologies for the quality control and standardization of the ayurvedic products like Vasa Swarasa, Vasa Avaleha (Table 11, 12), Vasa Ghrita[22,63], Guduchi Ghrita or Taila[64] and Shirisharishta[23] etc.

Discussion

The quality of a product or service refers to the perception of the degree to which the product or service meets the customer's expectations. It has no specific meaning unless related to a specific function and/or object. Quality is a perceptual, conditional and somewhat subjective attribute[3]. Ancient physicians were well vigilant about quality assurance of the drugs at raw, in process and finished level. It is also evident by a quote in Charaka Samhita, a physician should have proper knowledge about identification and nomenclature of herbs / folklore medicine also, besides their formulation techniques, dose schedule and therapeutic uses etc[62]. In this way, the Ayurvedic sciences or Shastras as they are called possess qualitative standards that are derived by a subjective but impersonal approach to standardization. While there is a contemporary value in applying modern science and technology tools for creating objective and verifiable standards for traditional knowledge products and concepts, currently the approach to creating standards is one-sided. This is because it does not adequately consult the available qualitative Traditional health sciences (THS) standards and parameters. Ayurveda has its own sophisticated internal quality standards. They include standards for identity, collection procedures, processing technology, finished products, drug design and therapeutic applications. The criteria for collecting plants, for instance, may include the best time, season and stage of growth when the plant is most therapeutically active. It may include the best habitats for gathering the plants, in order to peak their medicinal potency. Standards also exist for safety and efficacy of 'pharma ceutical', 'nutraceutical' and 'cosmeceutical' products. It is in this context of growing acceptance of Ayurvedic products and therapies that questions regarding their efficacy and quality standards have become a matter of serious concern to policy-makers, consumers and to the regulatory authorities in both the producing and importing countries. Today, government regulators do not take the epistemological differences, between traditional and western biomedicine, into account while setting standards to monitor quality in respect of consistency, safety and efficacy of ayurvedic products and services. Centuries of clinical evidence and practical methods for quality assurance that are available in the THS are thus overlooked. This unmindful neglect can be rectified by carefully translating the detailed and sophisticated traditional knowledge on identity, collection, processing and therapeutic applications into appropriate modern parameters, instead of setting standards ab initio. Modern tools of physics, chemistry and biology are indeed capable of objectifying the traditional standards that already exist. Microscopy is useful to the herbal sector in authenticating plant drugs. Also geology and marine sciences may be helpful in the availability of standard metal, minerals and marine raw materials. Advance analytical tools like HPTLC, HPLC, and Spectroscopy etc are also prove to be efficient for 'fingerprinting' of herbal products. The flame photometers and atomic absorption spectrophotometer, electron spectroscopy for chemical analysis and electron microscopy are useful for studying traditional

ayurvedic medicines that contains metals or minerals etc. Although these correlations are not so easy job but in long way it may be helpful to establish an inter-cultural approach for quality standard.

A programme to develop modern inter-cultural standards for quality, safety and efficacy of traditional Indian systems of medicine is not only important for Indians, but also for global consumers. However, the project to develop such standards needs an appreciation of the epistemology of Ayurveda[65].

Conclusion

Thus it is the need to build a bridge between traditional ayurvedic and modern scientific quality standards at various levels. Databases is needed to create on ayurvedic approach of identity of raw materials, collection methodology, specific processing of the materials, their specific combination in any formulation, finished products, dosage form and their uses etc. Scientific relevance of these concepts and approaches is also needed to be reestablished using modern scientific tools of chemistry, physics, biology and geography etc. It is also needed to identify the important physical, chemical and biological differences that are reflected when the traditional methods are followed, and demonstrate their relevance in establishing the quality, safety and efficacy of the products

Tables

Table 1: Acceptable quality of land for the procurement of herbs

No.	Description	Charaka	Sushruta	Vagbhatta
1.	Jangala (desert like) region	+	-	+
2.	Sadharana (moderate kind) region	+	-	+
3.	Having seasonal balance	+	-	-
4.	Soil should be even	+	+	+
5.	Attached/adjacent to water resource	+	+	-
6.	Suitable grassland	+	+	+
7.	Unctuous soil	+	+	+
8.	Black/golden coloured soil	+	+	+
9.	Yellowish/reddish coloured soil	-	+	-
10.	Sweet pleasant smelling	+	-	-
11.	Soil scattered by the plough	+	-	-
12.	Not in proximity of any dominating tree or herb	+	-	-

Table 2: Unacceptable quality of soil/place for the procurement of herbs

No.	Description	Charaka	Sushruta	Vagbhatta
1.	Burial ground	+	+	+
2.	Temples/worship places etc	+	+	+
3.	Road side	+	+	+
4.	Ravines and anthills	+	+	+
5.	Ushar (salty)/Bhangura (dry)	-	+	-

Table 3: Acceptable qualities of herbs

No.	Quality	Charaka	Sushruta	Vagbhatta
1.	Collected during suitable season	+	+	-
2.	Fully matured quality i.e. having maximum concentration of active constituents (Rasa-Virya etc)	+	+	+
3.	Physico-chemical or pharmacological qualities - not spoiled by any natural (sun/fire/water/air) or unnatural (insects) causes	+	+	+
4.	Spread wide with big roots directed towards north	+	+	+

Table 4: Collection of different parts in specific season

No.	Parts of drug	Collection season	Charaka	Vagbhatta
1.	Fresh branches & tender leaves	Varsha (rainy) and Vasanta (spring)	+	+
2.	Roots	Grishma (summer) or Shishira (dewy)	+	+
3.	Full grown leaves, barks, tubers and sap	Sharad (autumn)	+	+
4.	Pith & exudation	Hemanta (early winter)	+	+
5.	Flowers and fruits	Appropriate seasons	+	+

Table 5: Seasonal variation in alkaloid profile

Table 6: Seasonal variation in Total solid content

Table No 7: Asannapakva Avastha Lakshana of Avaleha

Signs	Illustration
Darvi Pralepatva	Stickiness of Sugar solution to ladle
Tantumatvam (1*Tar*, 2*Tar*)	When drop of in-process (during heating) sugar solution is put over thumb, keep the index finger over it and stretching of index finger produces thread in between thumb and index finger. The number of threads denotes the degree of consistency.
Appasu Majjanam with Saranam	When drop of sugar solution is poured into vessel filled with water, it sinks and spreads in water.
Appasu Majjanam with Sthiratva	The drop sinks to bottom but does not spread and easily picked with finger
Patitastu Na Shiryate	When drop is poured over plate, it does not spread or break.

Table 9: Completion test of Sneha paka

Paka	***Sneha***	***Kalka***	**Fire test**	
			Sneha	***Kalka***
Mridupaka	Without Moisture	Sticky	+ve	-ve
Madhyam Paka	Without Moisture	Can be molded into *Varti* (spindle) form	+ve	+ve
Khara Paka	Without moisture	Rough, dry, brittle	+ve	+ve

Table No 8: Supakva Avastha Lakshana of Avaleha

Signs	Illustration
Sukh Sparsha	Soft to touch/ soft texture
Sukh Marda	Feels soft even after rubbing between fingers i.e. non sticky consistency
Gandha–Varna-Rasattapoti	having taste, colour, smell as that of ingredients i.e. good palatability
Pidite Mudra	Forms impression of thumb when pressed indicates proper frying

Table 10: Determination signs for fermentation in Asava-Arishta preparations

Onset	Completion
Floating of *Prakshepa Dravya*	Sunken *Prakshepa Dravya*
Presence of effervescence	Absence of effervescence (froth)
Presence of hissing sound	No sound
Mild sour taste	Appreciation of sour taste and
Aroma of Prakshepa Dravya	Alcoholic aroma
Extinguishing of burning candle	Continuation of burning of a lighted candle
Lime water taste – milky colour	No change in appearance of lime water

Table No 11: Details of various R_f values of four samples i.e. Vasa Swarasa, Vasa Avaleha(S), Vasicine & Vasicinone

Sample	R_f value	R_f value	R_f value
Vasa Swarasa	0.18	0.59	0.90
Vasa Avaleha (S)	-	0.55	0.90
Vasicine (Std)	-	0.55	-
Vasicinone (Std)	-	0.52	-

Table No 12: Details of various Rf values of four samples i.e. Vasa Kwatha, Vasa Avaleha (K), Vasicine & Vasicinone

Sample	R_f value	R_f value	R_f value
Vasa Kwatha	0.22	0.73	0.97
Vasa Avaleha (K)	-	0.66	0.97
Vasicine (Std)	-	0.68	-
Vasicinone (Std)	-	0.73	-

T.L.C. studies, while comparing with standards shows that presence of Vasicine & Vasicinone in *Vasa Avaleha(S)*, and Vasicine in *Vasa Avaleha (K)*.

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