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REVIEW ON ARKA AND DISTILLATION

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ABSTRACT

Arka Kalpana is a liquid preparation obtained by distillation of certain liquids or of drugs soaked in water using the *Arkayantra* or distillation apparatus. Distillation is a powerful technique for separating the component substance from a miscible fluid mixture by means of selective evaporation and condensation. Distillation plays an essential role in many chemical processes and operations. According to Ravana's Arka Prakasha, the *Panchvidha Kalpanas* include *Kalka, Choorna, Rasa, Taila* and *Arka*. *Arka Kalpana* is given specific importance and it opines that it has more potency in comparison to the other *Kalpanas.* It is most potent due to *Dosharahithatva* and its specific *gunas.* Therefore arises a need to know the simplified procedures and methodologies involved in the preparation of this formulation which can be easily understandable and applicable in medical and pharmaceutical preparations.

KEYWORDS: Arka, Kalpana, Distillation, Arka Prakasha.

INTRODUCTION

The word *Arka* is derived from '*Ru – gatau'*. *Gati* means motion which denotes three different meanings Gyan, Gaman and Prapti.[1] In Arka process all these three meaning are to be accepted, as the knowledge of the contents of the drug is first thing Gyan, then the motion is given to the contents through water Gamanand lastly required amount of active content is obtained Prapti. Thus Arka contains the complete aspect of its manufacturing process by root word 'Ru-Gatau.' Arka Kalpana can be defined as a liquid preparation obtained by distillation of certain liquids or of drugs soaked in water using the Arkayantra[2] or distillation apparatus. The concept of Arka as a dosage form can be seen in different texts but the pharmaceutical aspect of Arka Kalpana is mentioned in detail mainly in Ravana's Arka Praksha.[3]

Historical Review: The word *Arka* is not mentioned in vedic literature as well as in *Samhitas* and *Sangrahas.* Shodhal was the first to describe the *Arka Kalpana* in 12th century. The main reference book of *Arka Kalpana* is *Arka Prakash* but there is no any explanation about the author of this text. This text book is in the form of conversation between Ravana and Mandodari. In the 14th Century, Unani Chikitsa was flourishing and *Arkas* were used frequently in that period by Unani Hakims. Some people say that *Arka Kalpana*, is not derived from our *Panchavidha Kashaya Kalpana*, but it is originated from Unani system of medicines. Rasa Tarangini gives a reference about *Arka Kalpana* among all Rasa Shatra books.[4]

Classification of *Arka*: - According to *Arka Prakasha.*

First classification of *Arka* is according to contents used for preparation. *Sthirarka* is *Arka extraction* from the drugs in which there is no volatile oil is present for example *Triphala* and *Dasamoola. Gandharka* is *Arka Patana* from the drugs with fragrance or volatile oil is present for example *Jiraka* and *Ajmoda. Dravarka* is *Arka* extraction from the liquid drugs. Second classification is according to duration of preparation of *Arka*. *Nyun* is prepared in 1 p\hr, *Madhyarka* is prepared in 2 p\hr, *Shreshthark* is prepared in 3 p\hr. Again *Arkas* are classified according to the diseases and its actions. Next classification is according to the part used for Arka extraction. They are *Pushparka, Kshiri Vruksharka, Taildhanyarka, Tndularka, Sattu Dhanyarka, Vipvargarka,* and *Sugandha Ganarka.*

Equipments required for preparation of *Arka:* The details of the method of preparation of *Arka Kalpana* is taken from *Ravana's Arka Prakash*. The equipments required for preparation of *Arka* are 1.*Chulla- Angi* or stove 2. *Lakadi*– coal along with kerosene oil 3. *Oushadha Dravya* - medicine 4. *Patra* – Glass bottles 5. *Yantra – Bhakka Yantra ,Varuni Yantra ,Tiryak Patina Yantra, Karanambika Arkayantra* and *Nadikayantra* 6. *Arka sangraharapatra*.[5] We should always consider the following points, while preparing *Arka*. The apparatus used in *Arka* preparation, process or methods used for *Arka* preparation and role of *Agni* in *Arka* preparation.[6]

Preparation of clay for apparatus: Mud was used for preparing of *Arka Patan Yantra* in olden days. Before

invention of modern technique the apparatus for distillation was being prepared. Iron powder, alum, black clay, red clay, bone powder, glass powder etc. was taken in equal quantities and clay should be mixed in equal quantity. Urine of cow, horse, goat, buffalo and elephant are mixed with clay. The clay should be dried in sunlight, till the smell of urine gets completely removed. In this way clay for manufacturing distillation apparatus is prepared.

Method of manufacturing apparatus: Round shaped vessel should be manufactured by pot maker from the above clay. The mouth of the pot should not be less than 3 *Angula* (3 cm.) For covering again same size of lid should be prepared and there should be lips of 3 *Angula* by which it is jointed with the vessel. Powder of old bones should be used to seal the joint to make it air tight. One small hole should be made in the lid. In this hole the tube of bamboo (One is small and another one is double the size of first one) is inserted and clay should be applied on the joints. So that fumes may not escape out. The small tube is inserted measuring 4-5 *Angula* inside the pot. *Arka patra* should be kept below the large tube. The fume that comes out from the pot is collected in that vessel and this vessel should be kept in cold water. In this way the fumes gets condensed & again collected in the form of *Arka.*

Method of preparation of *Arka*

According to *Arka Prakasha* the general method of *Arka* preparation has been explained. The required quantity of water is added to the drugs for soaking and kept overnight. Next day morning it is poured into the *Arka yantra* and the remaining water was added and boiled. The vapors get condensed and collected in a receiver. The aliquots collected in between contain the active ingredients and may be mixed together to ensure uniformity of the *Arka.* In Ayurveda Sara Samgraha, it is mentioned as drugs are soaked and kept overnight. Eight times of water must be added. *Madhyagni* (moderate fire) or *Teevraagni* (extreme fire) must be maintained during the procedure and only two third of the poured liquid must be collected.[7]

General method was explained in 2nd chapter of *Arka Prakash,* it is mentioned that for preparing *Arka* first of all, the drugs are to be coarsely powdered and ten times water should be added to it and it should be soaked for 24 hrs. Then *Arka* should be extracted by using *Arka Yantra.*

Special methods for preparation of *Arka* are also mentioned by *Arka Prakasha*. According to 5 types of *Dravyas*, which are used in the preparation of *Arka*, very hard drug, hard drug, fresh drug, twig , liquid drug. Though the method of *Arka* preparation is same as mentioned in general method, here water should be added according to the hardness of the drug. The drugs which are one year old and very hard like Sandal wood etc. are considered as very hard drug in which general method is applied for preparing *Arka* of such drugs. *Ajamoda, Trikatu, Kirata* etc. drugs are considered as hard drug. While preparing the Arka from such drugs two times water is to be added and kept for 12 hrs. After that Arka is to be prepared by using *Arka Patan Yantra*. Fresh drug are divided into two groups of juicy drugs like leaves and fruits and Juiceless drugs like fleshy drugs and fibrous drugs. Fresh drugs, which contain milk, are again divided into two groups milky which are mild and strong.

Arka can be extracted from wet drugs and dry drugs. If the drugs are soft and wet then 6 times of water should be added to the quantity of wet drug and extraction of *Arka* should be done up to 60%. If the drugs are wet and mildly hard then 8 times of water should be added to it and extraction of *Arka* should be done up to 60% to 70%. If the drugs are dry and soft they need not to be crushed. At the time of extraction they should be mixed with 6 to 8 times of water in the *Vabakayantra* and usage of mild fire for obtaining 60% to 70% of *Arka*. If the drugs are dry and hard then these are crushed into coarse powder form and soaked in 10 times of water for overnight. In the morning it should be placed in the *Vabakayantra* and mild fire for obtaining 60% to 70% of *Arka*. If the drugs are dry and moderately hard they need not to be crushed and 8 times of water is added to it and kept for overnight and in the morning it should be placed in *Vabakayantra* and mild fire for obtaining 60% of *Arka*.[8]

Importance of the *Arkas:* According to the above reference the efficacy of *Kalka, Churna, Swarasa, Taila* and *Arka* is gradually increasing in descending order. This efficacy of individual formulation may be due to various degrees in the concentration of active principle. This implies that the author of *Arka-Prakash* has said this on the basis of concentration of drug in formulations.[9] It can be preserved for longer time than other *Kalpanas* like *Swarasa* and *Kwatha*. *Arka Kalpana* is easy to administer in the patients of *Mridu Prakriti* patients and one who hesitate to take medicines like *Churna* and *Kwatha. Arka* is prepared by the combination of *Jala* and with the help of Agni. Hence *Arkas* are *Laghupaki, Vyavayi* and *Vikasi* and thus assimilates quickly in the body. *Arkas* have good palatability. *Arka Kalpana* acquires highest position in obtaining the potentially active volatile oils as the condensation takes place during the process of distillation.

Part used for Arka preparation	Amount of Water	Heating Duration
Leaves	1/100th part	24 hrs
Fruits	Without adding water	-
Green & Juiceless drugs	1/20th part	3 hrs
Flowers	1/16th part	3 hrs
Mrid milky drugs(Arka)	Kept in hot water for 3 days, then fresh water are added & crushed till milk secretion stops. Then 1/10th part of water is added -	-
Tikshna milky(Snuhi)		

Test of Arka: Taste and odour of the drug from which, *Arka Patan* is done must be present. When *Arka* is filled in different *Patra*, the colour of *Arka* should be similar to *Shankha, Kundan* and moon rays. Colour should not change if it is filled in *Jirnasthi Mrutika Patra.* General Dose of *Arka* is 12-24 ml.[10] *Anupana* is *Tambulbhakshana or Lavanga. Durgandhanashan Vidhi is* if *Arka* is having bad smell then it has to be fumigate with *Dhuma* produced by powder of *Hingu, Methika, and Rajika* are mixed in *Ghrita* and then it should be kept in *Navin Handi.* Storage of *Arka* should be in airtight glass bottles. Any *Arka* if kept open and exposed to air will loose its volatile medicinal principles.[11]

Precautions during preparation

While doing *Arka* preparation, distillation apparatus should be exposed with *Mandagni*, because boiling of the drugs with excessive heat will lead to water getting vaporized. Because of more heat very soon the water content will get vaporized and there is a chance of burning and spoilage of *Arka Dravya*. Then little bit *Arka* is produced which contains improper taste, smell and which will not be up to mark. The lid should be tightly placed and sealed around to prevent vapours from escaping. Heat is applied to the drug mixture and the distillate is collected in large bottles and mixed well to ensure uniform concentration of the medicine because the compared to that collected at the end of the process when the drugs are depleted.Continuous water current should be maintained in the condenser. When a copular type of condenser is used water is replaced by cool water when it becomes warmed up.The vessel or bottle in which the distillate is collected is placed in a container containing cool water.[12]

Distillation: Distillation is a powerful technique for separating the component substance from a miscible fluid mixture by means of selective evaporation and condensation. Distillation is of importance in many micro fluidic applications, including food processing, gas or liquid separation and biochemical industries. The term distillation refers to a general class of methods used to separate components from a mixture based on a difference in their volatilities. In general, a distillation process involves heating the liquid mixture to the vapor state so as to enable the selective condensation and withdrawal of the component(s) of interest. When the vapor and liquid phases flow in a concurrent direction, the separation efficiency is limited to a single ideal stage. If higher separation efficiency is required, the liquid and vapor are brought into counter-current contact. This method is referred to as fractional distillation, and is one of the most commonly used separation methods in the chemical process industry. In distillation processes, the extent of separation is governed by thermodynamic equilibrium, whereas the rate of separation is determined by the mass transfer. Miniaturizing the separation process has the advantage of improving the mass transfer performance through the production of large gradients and high surface-to-volume ratios. However, many common chemical separation processes, including distillation, absorption and stripping, rely on mass transfer across a gas-liquid interface, and establishing such an interface in micro channels represents a significant challenge.

Process of Distillation: In the process of distillation, condenser is mounted in the neck of the flask containing the material being treated. As vaporization occurs, the vapors enters the condenser, the pressure of the vapors causes the distillate to spurt out from it. At the same time, a certain amount of back pressure is produced by the presence of the liquid retained in the condenser and this interrupts the smooth progress of the distillation process.[13]

Distillation plays an essential role in many chemical processes and operations. Various large-scale distillation methods are available, including Heat Integrated Distillation Column (HIDC), Membrane Distillation (MD), cyclic distillation, cryogenic distillation and Reactive Distillation Column (RDC). Membrane distillation involves the thermal, vapor-driven transportation of the miscible fluid mixture through a micro-porous hydrophobic membrane. Of the various distillation techniques in common use, membrane distillation has many practical advantages, including a low equipment cost, good energy efficiency, and a low feed water pre treatment requirement. As a result, it is widely used in industry for such applications as environmental waste cleanup, food processing, and so on. The use of membrane distillation in small scale commercialized plants is well documented in the literature. However, with the maturation of micro fluidics technology, the application of membrane distillation at the micro scale has also attracted growing interest in recent years.[14]

Methods used for obtaining essential oils can be ranged as simple, fractional, vacuum, water steam distillations

and micro-wave assisted hydro distillation. Distillation methods are mainly based on the difference of boiling degree or the solvent and transport effect of water in the form of steam. Vacuum can be used for accelerating the process. The success of the methods is related to presence of undesirable compounds such as waxes, flavonoids, coumarone and deterioration rate of active compounds for whatever reason. Low-temperature water-steam distillation can avoid deteriorations but it cannot block the presence of the undesirable compounds. Micro-wave assisted hydro distillation is a new method resulting with the high degree pureness. But this method has not been placed well in commercial production of essential oils. Essential oils having a high potential to be used in medical care and food industry are also used as a feed supplement with the antimicrobial and antioxidant effects. It is aimed to discuss about the advantages, disadvantages of distillation methods against each other and their effects on quantity and the quality of active substances in this review.[15]

Comparison of methods used for obtaining essential oils: Obtaining essential oils from plants are traditionally made by using water distillation, steam distillation and solvent extraction methods. Although these processes appear to be advantageous at low cost, they have negative effects such as hydrolysis and heat-induced degradation. The use of solvents is not recommended because of the residues in the essential oils and the loss of essential oil from the solvent at the time of the evaporation (Charles and Simon, 1990). To overcome this disadvantage, supercritical fluids method has been developed and proposed (Mostafa et al., 2004). Some of the methods used to obtain essential oils can be ranged as pressurized liquid extraction, pressurized hot water extraction, membrane-supported solvent applications, solid-phase microextraction and ultrasound applications. Recently, microwave-assisted extractions have been used very efficiently because of the possibility of rapid heating of aqueous samples (Kosar et al., 2005; Chemat et al., 2006).

Distillation can be demonstrated in a simple laboratory distillation apparatus comprising a flask, distillation head, condenser, and sample collector (Figure 1). A thermometer is included in the apparatus as shown to monitor the progress of the operation. In its simplest form this procedure results in a separation into a volatile fraction collected in the receiver flask and a non volatile residue in the distillation flask. When a distillation column is incorporated in the equipment, the evaporation and condensation processes occur continuously. This results in a progressive fractionation of the volatiles as they pass up the column. The most volatile components emerge from the top of the column initially and the less volatile components emerge later. By changing the receivers throughout the course of the distillation a separation or fractionation is effected. Eventually, all the volatiles will have passed over into the sample collectors and any in volatile residue present will remain in the distillation flask.[16]

Types of Distillation[17]

Important types of distillation include are simple distillation, fractional distillation, steam distillation, vacuum distillation, air-sensitive vacuum distillation, short path distillation, zone distillation.

1. Simple Distillation: Simple distillation involves heating the liquid mixture to the boiling point and immediately condensing the resulting vapors. This method is only effective for mixtures wherein the boiling points of the liquids are considerably different (a minimum difference of 25^{o}C).The purity of the distillate (the purified liquid) is governed by Raoult's law. Water distillation, known as the oldest method (Figure 1), is the most appropriate method to apply to fresh and dry plant parts which are not damaged by heating. The application is carried out by boiling water added to the top of the vessel where the plant is placed, transportation of essential oil by vapor and accumulating in the water due to density difference when it reaches the collecting vessel called Florentine Container (Başer et al., 1998).

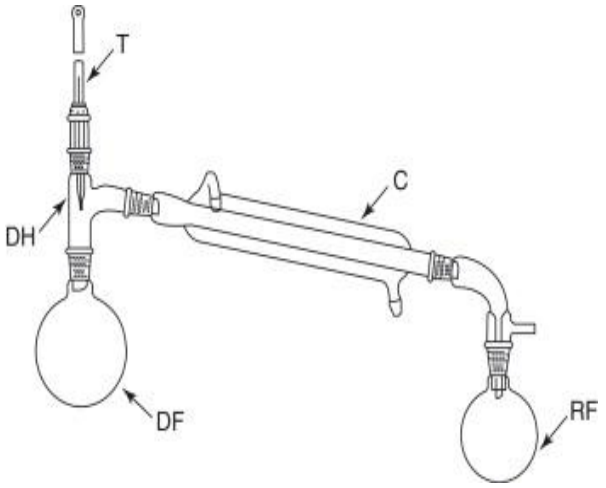

Figure 1: Simple distillation apparatus comprising Distillation Flask (DF), Distillation Head (DH), Thermometer (T), Condenser (C), and Receiver Flask (RF) Reproduced from Furniss BS, Hannaford AJ, Smith PWG, and Tatchell AR (1989) Vogel's Text book of Practical Organic Chemistry, 5th edn, Pg no. 168.

2. Fractional Distillation: Fractional distillation is often used to separate mixtures of liquids that have similar boiling points. It involves several vaporization-condensation steps, which takes place in a fractioning column. This process is also known as rectification. The apparatus required to perform a fractional distillation are a round-bottom flask or distilling flask, a source of heat, which can be a fire or a hot bath is used. Receiving flask to collect the condensed vapors, fractioning column and thermometer to measure the temperature in the distilling flask, condenser and standard glassware. When heated, the liquid mixture is converted into vapors that rise into

the fractioning column. The vapors now cool and condense on the walls of the condenser. The hot vapors emanating from the distilling flask now heat the condensed vapor, creating new vapors. Many such vaporization condensation cycles take place and the purity of the distillate improves with every cycle. An illustration depicting a fractional distillation setup is provided below.

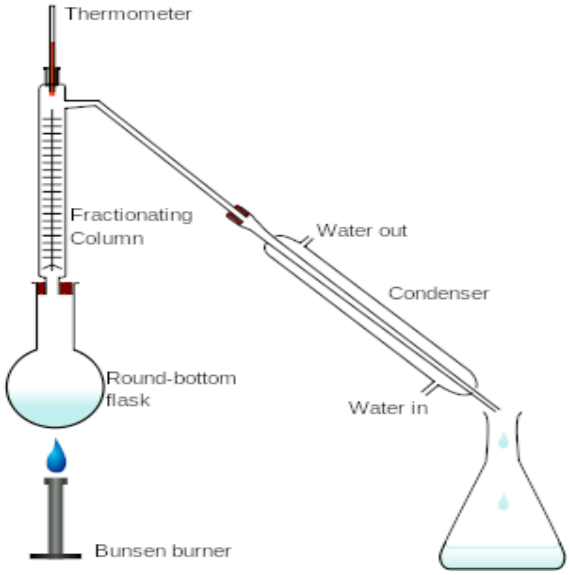

Figure 2.

3. Steam Distillation: Steam distillation is often used to separate heat-sensitive components in a mixture. This is done by passing steam through the mixture when slightly heated to vaporize some of it. The process establishes a high heat transfer rate without the need for high temperatures. The resulting vapor is condensed to afford the required distillate.The process of steam distillation is used to obtain essential oils and herbal distillates from several aromatic flowers/herbs. The distillation method in which steam with a certain amount of moisture is sprayed on the plant material placed on the grid in a similar system to water distillation and steam transfer of the essential oils is known as (Figure 1) steam distillation. Steam distillation is essentially a process of distilling plant material with steam generated by a boiler. In this method, the material is placed on a perforated plate above the steam inlet. It is easy to control how much steam is generated in the steam generating mechanisms. Furthermore, since the steam generator is outside of the distillation unit, the ambient temperature at which the material to be distilled is located is kept below 100° C and the occurrence of impairments due to the heat effect can be prevented or reduced (Öztekin and Soysal, 1998). The biggest problem of the steam distillation is the vapor pressure and the degradation which can occur when the flow rate is high.

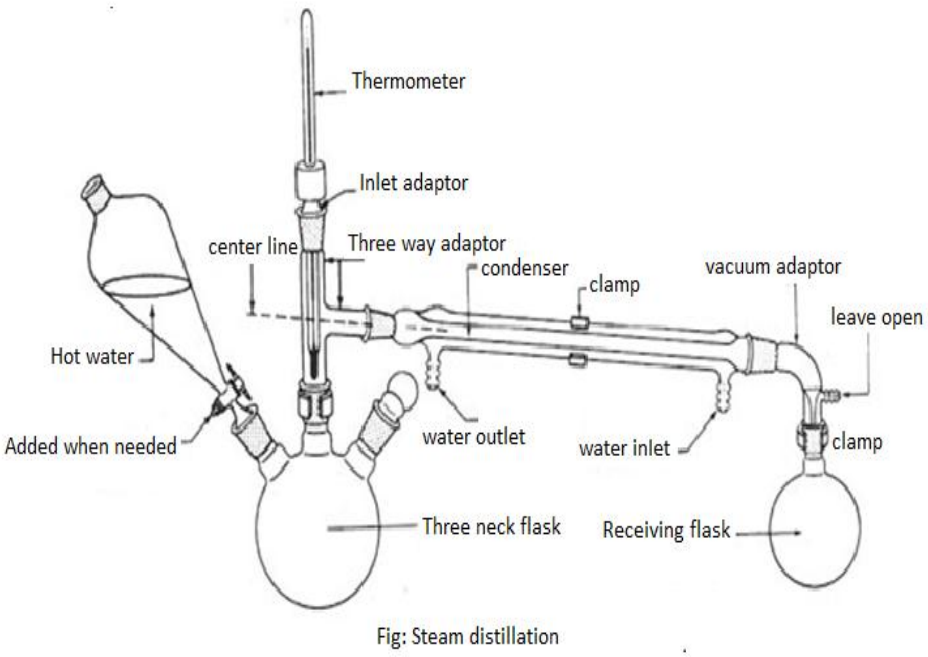

Figure 3.

4. Vacuum Distillation: Vacuum distillation is ideal for separating mixtures of liquids with very high boiling points. In order to boil these compounds, heating to high temperatures is an inefficient method. Therefore, the pressure of the surroundings is lowered instead. The lowering of the pressure enables the component to boil at lower temperatures. Once the vapor pressure of the component is equal to the surrounding pressure, it is converted into a vapor. These vapors are then condensed and collected as the distillate. The vacuum distillation method is also used to obtain high-purity samples of compounds that decompose at high temperatures. The boiling points of some compounds are quite high. However, they can be distorted even at temperatures below the boiling point. It is a difficult and inadequate method to extract these compounds under atmospheric pressure. It is therefore more effective to reduce the pressure rather than increase the temperature to avoid deterioration and this method is called vacuum distillation. As it is known, if the boiling point decreases as the outer pressure decreases the pressure is lowered below the vapor pressure of the compound and boiling with distillation begins.(Kılıç, 2008).

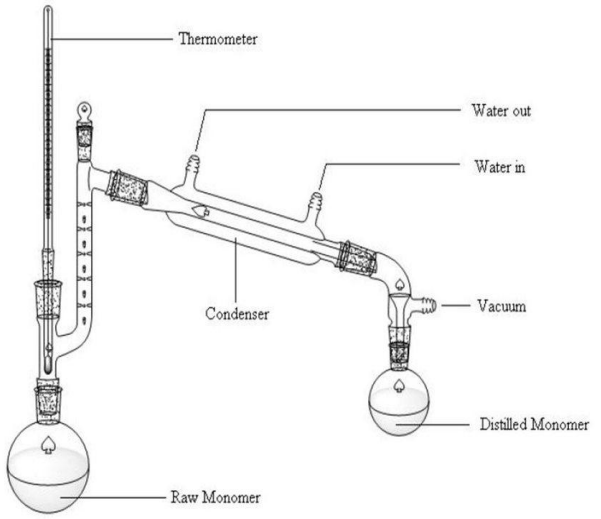

Figure 4.

5. Air-Sensitive Vacuum Distillation: For compounds that are sensitive to air and readily react with it, the vacuum distillation process is carried out but the vacuum must be replaced with an inert gas once the process is complete. Such a process is often referred to as air-sensitive vacuum distillation.

6. Short Path Distillation: Short path distillation is used to purify a small quantity of a compound that is unstable at high temperatures. This is done under lowered pressure levels and generally involves the distillate travelling a very small distance before being collected (hence the name 'short path'). The reduced distance travelled by the distillate in this method also reduces the wastage along the walls of the apparatus.

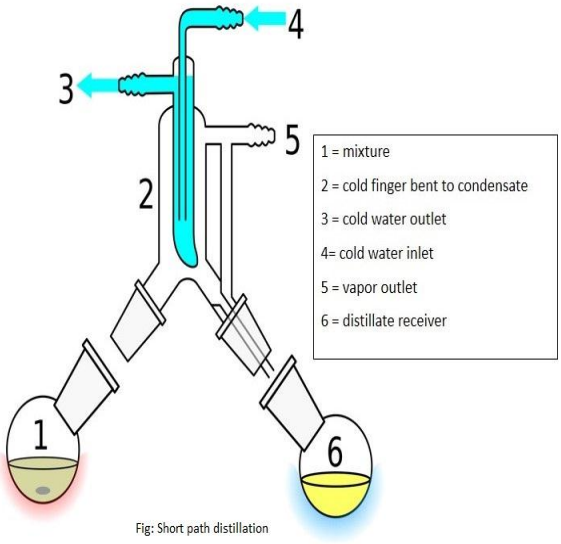

Figure 5.

7. Zone Distillation: The process of zone distillation involves the partial melting of a substance and the condensation of the resulting vapors to obtain a pure distillate. This is carried out in a long container with the help of a zone heater.

8. Super critical liquid extraction: This is done by using water as solvent between 100 and 374 °C and applying a pressure that is high enough to protect the liquid. It has been suggested that it is a powerful alternative to the extraction of solid materials and its use in practice is promising (Basile et al., 1998; Luque de Castro et al., 1999).

9. Microwave assisted water distillation: Microwave assisted water distillation, supercritical fluid extraction and ultrasonically assisted extraction methods have been developed and used to increase the quality of essential oils obtained by shortening the extraction period, increasing the efficiency and reducing the cost (Kaufmann and Christen, 2002). Microwave assisted water distillation has previously been reported to be used in plants such as Cuminum cyminum, Zanthoxylum bungeanum and Xylopia aromatica but many more important plants such as thyme is needed to be studied (Stashenko et al., 2004; Wang et al., 2006).

DISCUSSION

Arka kalpana is one among the *Panchvidha Kalpanas* include *Kalka, Choorna, Rasa, Taila* and *Arka. Arka Kalpana* is given specific importance and it opines that it has more potency in comparison to the other *Kalpanas*. Many number of dosage forms are being converted to *Arka* due to its reduced dose, patient compliance and increased potency. A detailed explanation regarding all the aspects in the manufacture of *Arka* is seen in *Arka prakasha* by Ravana. Seven different types of classification of *Arka* are mentioned in different literatures. They are based on contents part used duration of preparation action on *Doshas, Manogunas, Ritus* and

disease. We can understand that the *Arka yantra* told in the classics and the modern day distillation apparatus are following same principles of science i.e. distillation which clearly states the significance of the detailed procedures explained. The method of distillation has a considerable history, dating back to 3000 BC. Evidence suggests that the distillation of alcohol was developed as far back as the 9th century. Some important applications of distillation are listed below. Distillation plays an important role in many water purification techniques. Many desalination plants incorporate this method in order to obtain drinking water from seawater. Distilled water has numerous applications, such as in lead-acid batteries and low-volume humidifiers. Many fermented products such as alcoholic beverages are purified with the help of this method.Many perfumes and food flavorings are obtained from herbs and plants via distillation. Oil stabilization is an important type of distillation that reduces the vapor pressure of the crude oil, enabling safe storage and transportation. Air can be separated into nitrogen, oxygen, and argon by employing the process of cryogenic distillation. Distillation is also employed on an industrial scale to purify the liquid products obtained from chemical synthesis.

CONCLUSION

Arka Kalpana is one among the extraction methods in Ayurveda, where volatile bioactive compounds of a drug are extracted using hydro-distillation process. The authentic references of Arka Kalpana are available in the classical text book Arka Prakasha. Arka Kalpana is correlated with Distillation in modern pharmaceutics practices. In this paper an effort has been made to compile about Arka, its classification, method of preparation, with distillation its types and method of preparation. Arka kalpana is a very unique formulation in Ayurvedic Pharamaceutics for its method of preparation and efficacy. The factors like Arka yantra, Agni, method of preparation have a significant role in preparation of Arka. Therefore more pharmaceutical study and research work to be done for developing the dosage form without violating the basic principle of Arka kalpana.

REFERENCE

1. Ravana Indradev Tripathy, Arkaprakash 2nd ed.varanasi, Chowkamba Sanskrit series, 2006; 1,8,9.
2. Ravana, Indradev Tripathy, Arka prakash, 2nd ed.Varansi, Chowkhamba Sanskrit Series, 1967; 99.
3. Ravana, Indradev Tripathy, Arka prakash, 2nd ed.Varansi, Chowkhamba Sanskrit Series, 1967; 118.
4. Sharma Sadanana, Rasatarangini, Shastri Kashinath, Hindi commentary, Motilal Banarasi Das, Delhi, 2000. R.T (2/159).
5. Dwived Vishwanada, Dwived Vishwanada Gananada Bharateeyabhaishjya Kalpanavijanana, 3rd Varansi, Krishnadas Ayurveda Series, 2006; 268.
6. Lankapati Ravanakrita, Arkaprakash, Commentary by Indradev Tripathi, Chukhambha publication, Varanasi, Ed, 2006; 1/52-58, 11.
7. Vaidhyanath, Ayurveda Sara Samgraha. Ayurveda Bhavan, 1st ed. Calcutta, 2002; Vol1 p.557-556.
8. Sharma Sadanana, Rasatarangini, Shastri Kashinath, Hindi commentary, Motilal Banarasi Das, Delhi, 2000.R.T (2/159).
9. Lankapati Ravanakrita, Arkaprakash, Commentary by Indradev Tripathi, Chukhambha publication,Varanasi, Ed, 2006; 1/46,9.
10. Pharmaceutical standards for Ayurvedic formulations, CCRAS Publications, New Delhi, 1987.
11. Dr. Jalpa h. Jani and Dr. Kapil Pandya, Arka Kalpana, A Review W.S.R. to Distillation, International Journal of Advance Research, ISSN: 2320-5407 Int. J. Adv. Res, 5(7): 867-872.
12. Gite Shweta, Kurkute B. R. , Suryawanshi Renuka and Tapre Sachin, Arka Kalpana- A Developing science, World Journal of Pharmaceutical and Life Sciences, wjpls, 2020; 6(4): 116-119.
13. Henry M. Durlage, Joseph, Charles and L. Wait., Fundamental Principles and Process of Pharmacy.
14. Ruey Jen Yang, Chan-Chiung Liu, Yao-Nan Wang, Hui-Hsiung Hou, Lung-MingFu, A comprehensive review of micro-distillation methods, Chemical Engineering Journal, 1 April 2017; 313: Pages 1509-1520.
15. Ahmet AKDAĞ, Ergin ÖZTÜRK Ondokuz Mayis University, Agricultural Faculty, Distillation Methods of Essential Oils, Department of Animal Science, SAMSUN https://www.researchgate.net/publication/332801584
16. J.D. Green, Distillation in Encyclopedia of Analytical Science (Second Edition), 2005.
17. Henry M. Durlage, Joseph, Charles and L. Wait, Fundamental Principles and Process of Pharmacy.