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A Review on Selection of Vessels in Pharmaceutical Preparations

Author: Seema M. B.¹

Co Authors: Hirehal Neha², Sushmitha V. S.³ and Amit Kumar Karna³

¹Department of Rasashastra and Bhaishajya Kalpana, Govt. Ayurveda Medical College, Bangalore, KA, Karnataka

²Shri Kalabyraveshwara Swamy Ayurvedic College Hospital and Research Center, Bangalore, KA, Karnataka

³Department of Rasashastra and Bhaishajya Kalpana, SDM College of Ayurveda, Udupi, KA, India

³Department of Rasashastra and Bhaishajya Kalpana, Central Ayurveda Campus, Dang, Nepal

ABSTRACT

Storage containers are a part of day-to-day life for the preservation of commodities such as water, milk, curd etc. It is also used widely for storage of various raw drugs and pharmaceutical preparations which brings about *Samskara*. The term *Samskara* in *Ayurveda* is introduced as “*Samskaro hi Gunantaradhanam*” which refers to the qualitative changes that occur due to incorporation of certain specific qualities i.e. changes brought about in the drug or food. One among the *samskaras* is *Bhajana* (vessel), which is used for the preservation or processing. As far as the pharmaceutical process is concerned, mud pot is advised to be used in place of *anukta* (untold) context because of its inert nature. This is applicable even for food preservation. In certain pharmaceutical preparations, vessels for processing are specified. Nowadays due to large scale manufacturing, use of alternative containers or vessels for the preservation of raw material or end products and pharmaceutical processing has become inevitable.

Aluminium and plastic are the commonly used containers. The use of aluminium containers for cooking and pharmaceutical preparations may alter the chemical composition of food or medicament. Use of low quality plastic containers may result in skin diseases, ulcer, cancer, birth defects etc. So, the guidelines mentioned in WHO and GMP have to be followed for the selection of containers for processing and preservation. Before selecting the container or the vessel, the compatibility of each drug or each end product must be well studied and implemented.

Key Words *Bhajana, Container, Preserve, Samskara, Food*

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INTRODUCTION

Plants, animals, metals and minerals are the different sources of medicine in *Ayurveda*¹. These drugs are converted into herbo- mineral, poly- herbal and metallic formulations. Any raw drug or the end product, if not potent to cure the disease, is of no use. Standardization of pharmaceutical preparations starts from the

collection of raw drugs and ends in packing of the final product. The container or the vessel which is used in the preservation of raw drugs during the process and end product plays a very important role in the safety and efficacy of the product.

In the classical texts, both *Ahara* (food) and *Oushadhi* (medicine) are given equal

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importance. It is a well-established fact that *Ahara* is *rasa pradhana* (more nutritional value), whereas the *Oushadhi* is *veerya pradhana* (More medicinal value)². Our *Acharyas* not only stressed the proper identification of a required herb, but also gave guidelines to procure a potent herb. Further to alter or enhance the *veerya* (potency) they formulated four factors that can determine the outcome of a formulation's therapeutic effect. A formulation becomes capable of producing maximum therapeutic effect when its potency is augmented by *Desha Sampath* (Collecting the plants from the appropriate habitat), *Kala Sampath* (Collecting the plants in the appropriate season), *Guna Sampath* (Collecting the plants when these are enriched with excellent attributes), *Bhajana Sampath* (Storing collect drugs in an appropriate container)³. Hence *Bhajana* (container) plays a major role in deciding the pharmacological action of the product.

After the collection of herbal/ mineral or animal drugs, preserving these in a proper container is very important. *Dravya* (drug) must be preserved according to its form like solid/ liquid, Dry/fresh⁴. Even *Acharya Charaka* has specified to use the container which is having similar properties to that of material stored. A beautiful quotation is given by *Acharya Vagbata* as **“Even the *amruta* (Nectar) which is obtained by churning ocean of milk will act as *Halahala Visha* (poison), if placed in an inappropriate vessel⁵”**. In this article an attempt has been made to highlight the importance of selection of

containers for storage or processing of food and medicine with few examples.

MATERIAL AND METHODS:

The main aim of *Ayurveda* is to maintain good health and to cure diseases. In *Ayurvedic* literature, equal importance is given to both food and the drug. Food is stored by almost every being of the human society. Storing food has several purposes like enabling a better-balanced diet throughout the year, storage of harvested and processed plant and animal food products for distribution to consumers etc.

Containers were used for following purposes in the ancient period:

1. Preservation of drugs/ food grains
2. Pharmaceutical process
3. Preservation of the end product

1. Containers used for the preservation of drugs/ food grains:

Under the context of *Bheshajagara*, *Acharya Charaka* emphasizes that the container used for storing drugs should attribute **similar quality to those of the drugs**, properly lidded and hung by the ceiling⁶. This scientific approach of *Acharya Charaka* generalizes the vessel to be used. For example, salt cannot be preserved in a steel container for a longer duration, if preserved it corrodes the vessel. In addition to this, *Acharya Sushruta* mentions tying of the drugs in cloth bags and their storage in earthen vessels or wooden containers and suspension from the ceiling⁷. Even in *Rasagrantha*, the use of

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metallic, bamboo pipes and utensils made of gold, iron, copper, bronze, stones and leather, *kundi* (pot- like structure) prepared from the skin of goats, sheep etc. are seen⁸. The containers used

for the preservation of raw drugs, food preparation and preservation⁹ and the impact of vessels on the food stored are mentioned in Table No. 1, Table No. 2 and Table No. 3 respectively.

Table 1 Containers used for preservation of raw drugs

Sl.No.	Name of the material	Container
1.	Herbal Raw drug	Mud pot/ Cloth ⁷ <i>Anuroopa guna bhajana</i> ⁵ (Quality of container should be similar to that of contents)
2.	Ghee	Should not be preserved in Bronze vessel ¹⁰
3.	Old Ghee	The old ghee which is preserved in the iron container is more beneficial in the treatment of <i>Timira</i> and all types of eye diseases ¹¹
4.	Mercury	Iron container (Mercury does not react with Iron)

Table 2 Container used for food preparation and preservation⁹

Sl.No.	Name of food/ liquid	Container/ vessel
1.	Ghee	<i>Krushna loha patra</i>
2.	Any liquid (milk etc.)	Silver
3.	Fruits, vegetables etc.	Wicker container (A basket of split bamboo)
4.	Dried and fried meat	Gold vessel
5.	<i>Manda</i> (Rice gruel), <i>Mamsa rasa</i> (Meat soup)	Silver vessel
6.	<i>Khada</i> (Tuber), <i>Katvara</i> (type of butter milk), <i>Souveeramla</i> (Fermented product), <i>Kanji</i> (Fermented product)	Stone container
7.	Boiled and cooled milk with fat content. (According to <i>Manusmriti</i> , milk without fat content cannot be kept in a Copper vessel).	Copper vessel
8.	Water, <i>Panaka</i> (<i>Sharbat/ Juice</i>), <i>Madhya</i> (Alcoholic preparations)	Mud pot
9.	<i>Raga Shadava</i> (Liquid gruel with fruit juice)	Diamond or <i>Vaidurya</i> vessel

Table 3 Vessels and its impact on the food stored (*Bhojana Kutuhala*)

Sl.no	Vessel	Benefits
1	Gold	Alleviates <i>doshas</i> , improves sight
2	Silver	Alleviates <i>doshas</i> , improves sight
3	Bell metal	Improves appetite and helps in purification of blood
4	Brass	Alleviates <i>Kapha</i> , aggravates <i>Vata</i> and destroys worms
5	Iron	Reduces swelling and treats Anemia and Jaundice
6	Earthen	Brings misfortune
7	Wooden	Improves appetite and aggravates <i>Kapha</i> .
8	Crystal	Pure and cool

2. *Vessel used during the pharmaceutical process.*

The importance of selecting a vessel during processing of food or medicine is highlighted in many pharmaceutical preparations. Here the properties of the vessel are expected to be imparted in the formulation. This has been

detailed in the context of *Samskara* (process standardization). Though most of the herbs are non- reactive chemically, even in such circumstances the usage specific type vessel/ container is emphasized to improve the prevailing qualities of medicine. Different vessels

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specified for pharmaceutical preparations with their advantages are listed out in Table No. 4.

Acharya Charaka in the context of rejuvenation therapy has advised to apply paste of *Triphala* to the iron vessel and keep it undisturbed for one day¹². While describing the qualities of *Kantha Loha*, the *Rasagranthas*¹³ have given beautiful explanation.

1. If a drop of oil is placed in the vessel containing water, oil will not spread.

2. *Hingu* (*Ferula asafetida*) when applied to the vessel loses its odour.

3. If *Nimba Kalka* (*Azadirachta indica*) is applied to *Kantha loha patra*, it loses its bitterness.

4. If milk is boiled in this vessel, milk will not spill out; instead, it attains conical shape. These qualities show the importance of the vessel.

If *Anukta* (untold), the medicine needs to be prepared in an earthen pot as it is inert for the herbo- chemical constituents¹⁴.

Table 4 Vessels used during pharmaceutical process and their advantages

Sl.No.	Name of the preparation	Vessel used	Remarks (Probable reasoning)
1.	All five basic preparations and <i>upakalpana</i> (Sub- classification of basic formulations)	Mud pot ¹⁵	Non reactive
2.	<i>Anna</i> (Rice preparation)	Rice prepared in mud pot will be heavy. Rice prepared in copper or iron vessels will be light for digestion ¹⁶ .	Effect of food on digestive system
3.	<i>Kshara Kalpana</i> (Basic extract)	Iron vessel ¹⁷	The iron of today's quality imparts a blackish colour which is against the characteristics of good <i>kshara</i> . Henceforth stainless steel is preferred
4.	<i>Saraswatharishta</i> (alcoholic medicament)	Gold vessel ¹⁸	Improves and imparts good quality
5.	<i>Asava/ Arista</i> (fermented products)	Mud pot/ gold ¹⁹	Inert nature of the material; imparts quality to the prepared <i>asava</i> or <i>arishta</i>
6.	<i>Sneha Kalpana</i> (lipid products)	Copper vessel- Best Iron Vessel- Medium Mud pot- Least ²⁰	Copper and Iron retains heat for long time and also impart their qualities into the processed material; mud pot is inert but absorbs the oil/ ghee during the processing.
7.	<i>Siktha Taila</i> (ointment preparation with bee wax)	Tin coated vessel ²¹	Tin is non- toxic and is non- reactive which renders them safe for utility; it is inert to acidic materials in the food or medicines which are prepared
8.	<i>Pottali Kalpana</i> (Mercurial preparations)	Mud Pot with silk cloth ²²	Mud pot is non- reactive to Sulphur and the silk cloth facilitates penetration of liquid Sulphur into the <i>pottali</i> where the compound placed has to undergo necessary chemical changes
9.	<i>Loha parpati</i> (mainly incinerated iron is used)	Triturated in Iron vessel ²³	Increases the potency/ quality and the vessel is inert to Mercury
10.	Purification of <i>Guggulu</i>	In Iron vessel ²⁴	It may impart qualities into the <i>Guggulu</i>
11.	<i>Kritrima Hingula nirmana</i>	<i>Mridanga yantra</i> ²⁵	Facilitates proper mixture of the components due to the instrument

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			design.
12.	<i>Abhraka amriteekarana</i>	<i>Loha bhajana</i> ²⁶	Thermo- stability
13.	<i>Satwa shodhana</i>	<i>Lohadanda kuttana</i> ²⁷	To impart pressure required for appropriate mixing/ size reduction
14.	<i>Abhraka satwa marana</i>	<i>Kachakoopi</i> ²⁷	Thermo- stability and ease in collection of material at the end of the procedure
15.	<i>Kritrima Haratala nirmana</i>	<i>Damaru yantra</i> ²⁸	To provide an area for sublimation; mud pots being inert do not react with the Arsenic
16.	<i>Rasamanikya nirmana</i>	<i>Abhraka patra</i> ²⁹	Inert nature of <i>Abhraka</i> towards Arsenic and to observe the change in colour which determines the end- point of the procedure
17.	<i>Talaka satwapatana</i>	<i>Kachakoopi</i> ³⁰	Thermo- stability and ease in collection of material at the end of the procedure
18.	<i>Shankha dravaka</i>	<i>Mritliptajataraka kachakoopi</i> ³¹	Thermo- stability and inert nature of glass bottle towards the final product
19.	<i>Nimbukamleeya shookaja</i>	<i>Kaachapaatra</i> ³²	Glasswares are inert to alkali
20.	<i>Nimbukamleeya sarjika- melana</i>	<i>Kaachadilipta paatra</i> ³³	Glasswares are inert to alkali
21.	<i>Tankana shodhana</i>	<i>Kshudra kataha</i> ³⁴	<i>Tankana</i> is an alkali hence an inert material must be used for its processing
22.	<i>Tankanamla nirmana</i>	<i>Kachapatra</i> ³⁵	Inert nature of glassware towards alkali
23.	<i>Sorakadrava nirmana/ sajala sorakadrava nirmana</i>	<i>Kachakoopi</i> ³⁶	Inert nature of glassware towards alkali
24.	<i>Romaka lavana nirmana</i>	<i>Mritlipta Handika</i> ³⁷	Mud pots are feasible to process the salts as they do not react
25.	<i>Lavana draava nirmana</i>	<i>Kachakoopi</i> ³⁸	Inert nature of glassware towards salts
26.	<i>Gandhaka shodhana</i>	<i>Lohapatra</i> ³⁹	Heating capacity and inert nature of iron towards Sulphur
27.	<i>Svarna shodhana</i>	<i>Sharava rodhana</i> ⁴⁰	Facilitates proper processing, inert to gold and prevents the exposure of gold to the products of combustion
28.	<i>Loha bhasma nirmana</i>	<i>Tamrapatra</i> ⁴¹	Copper vessel aid oxidation of iron and hastens the calcination
29.	<i>Druti nirmana</i>	<i>Moosha</i> ⁴²	Melting of a metal requires higher temperature and <i>moosha</i> is highly thermo- stable due to the materials used for its preparation
30.	<i>Satwa patana</i>	<i>Moosha</i>	Extraction of a metal from a ore/ mineral occurs at very high temperature which can be withstood by <i>moosha</i> because of the materials used for its preparation
31.	<i>Naga bhasma nirmana</i>	<i>Vighattana</i> ⁴³	To ensure proper mixing
32.	<i>Sarvaanna, vyanjana, soopa etc. except amla dravya</i>	<i>Vartalohapatra</i> ⁴⁴	<i>Deepana, pachana</i> ; the material is inert to the alkaline nature of the food which is prepared; acidic food could react to the <i>varta loha patra</i> which makes it an exception for storage in these vessels

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3. Preservation of finished product:

The preservation of finished products is unavoidable as many of the preparations are herbal, mineral, animal or a judicious combination of them. These have medico-nutritive value, may be perishable, if not properly preserved. Further, for the extension of shelf-

life, avoidance of undue contamination, mishandling, rodents, environmental influence etc. preservation has been given due regards in classics⁷. The lists of containers mentioned in classics to preserve the finished products and preservation of *Anjana* are presented in Table No. 5 and Table No. 6 respectively.

Table 5 Vessels used to preserve finished products

Sl. No	Name of the preparation	Vessel used	Remark (Probable reasoning)
1.	<i>Ksharas</i> (alkalis)	<i>Ksharas</i> are particularly preserved in the narrow-mouthed vessel ¹⁷	To avoid humidity because it's hygroscopic.
2.	<i>Choornodaka</i> (lime water)	<i>Choornodaka</i> is preserved in a green coloured glass bottle ⁴⁵	Green bottles maintain stable temperature and also protects the components stored in it against light
3.	<i>Guggulu</i> (Gum of <i>Commiphora mukul</i>)	<i>Guggulu</i> is preserved in an Iron vessel smeared with ghee ²⁴	Ghee prevents sticking of contents on the walls of container and thus prevents wastage. It acts as a protective layer and preserves the quality for longer duration.
4.	<i>Meshashrunga</i> (Sheep horn)	To preserve <i>Shankadi anjana</i> ⁴⁶	Where the maximum raw drugs are from <i>Samudra</i> i.e., alkaline nature.
5.	<i>Churnanajana</i>	To preserve elephant tusks, a container made of alum, <i>Vaidurya</i> (Cat's eye), <i>Shankha</i> (Conch Shell), stone, wood of <i>Asana</i> (<i>Pterocarpus marsupium</i>), gold, silver, horn is used ⁴⁷	The container may impart its quality to the material
6.	<i>Kamsyadi varti</i>	During the pharmaceutical preparation of <i>Kamsyadi varti</i> , <i>Tamra Patra</i> (Copper vessel) is used for paste application ⁴⁸	Copper may enhance the quality of the product.
7.	<i>Gomutradi Rasakriya</i>	Should be preserved in a bamboo container ⁴⁹	Bamboo is non-toxic. <i>Gomutra</i> is alkaline in nature which may react with containers made of metal. Hence Bamboo may be an ideal choice for its preservation.
8.	<i>Ajamoda anjana</i>	Preserved in the container made of wood of <i>Khadira</i> (<i>Acacia catechu</i>) ⁴⁹	The qualities of <i>Khadira</i> may be imparted into the <i>anjana</i> enhancing its quality.
9.	<i>Madhya</i>	Must be preserved in an appropriate vessel. In some of the contexts, <i>Acharya</i> mentions use of gold/ silver vessel ⁵⁰	The gold and silver nanoparticles may be incorporated in to the alcoholic media.
10.	<i>Bruhatimooladi Lepa</i>	<i>Bruhatimoola</i> (<i>Solanum indicum</i>), <i>Yashtimadhu</i> (<i>Glycyrrhiza glabra</i>), <i>Tamra</i> (Copper), <i>Saindhava lavana</i> (Rock salt), <i>Amalaki</i> (<i>Phyllanthus emblica</i>) are made into paste and applied on a copper vessel ⁵¹	The <i>Kaphahara</i> and <i>lekhana</i> property of Copper may be incorporated into the <i>lepa</i> .
11.	<i>Hinguladya malahara</i>	<i>Kachakoopi</i> ⁵²	Inert nature of glass vessel towards the components of the formulation
12.	<i>Haratala bhasma</i>	<i>Kachakoopi</i> ⁵³	
13.	<i>Talakodaya</i>	<i>Kachakoopi</i> ⁵⁴	

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	<i>malahara</i>	
14.	<i>Tankanamrita malahara</i>	<i>Kachakoopi</i> ⁵⁵
15.	<i>Tankanamla malahara</i>	<i>Kachakoopi</i> ⁵⁶
16.	<i>Tankanamla drava</i>	<i>Kachakoopi</i> ⁵⁶
17.	<i>Vanga rasayana</i>	<i>Karanda</i> ⁵⁷

Table 6 Preservation of *Anjana* (Collyrium) as mentioned in *Sushruta Samhita*⁴⁷

Rasa of Anjana	The material of the vessel for preservation
<i>Madhura</i> (Sweet)	Gold
<i>Amla</i> (Sour)	Silver
<i>Lavana</i> (Saline)	Horn of Deer
<i>Katu</i> (Pungent)	<i>Vaidurya</i> (A gem known as Cat's eye)
<i>Tiktha & sheetha guna yuktha</i> (Bitter and cold potency)	<i>Kamsya Patra</i> (An alloy known as Bronze)
<i>Kashaya</i> (Astringent)	Copper or iron

Contemporary aspects of container:

As per Good Manufacturing Practice Schedule-T (Rule-157), well washed, cleaned and dried glass bottles, vials and jars must be used as containers. Regarding the storage of raw materials, “The manufacturer, based on the experience and the characteristics of the particular raw material used in *Ayurveda*, *Siddha* and *Unani* system, shall decide the use of appropriate containers which would protect the quality of the raw material as well as prevent it from damage due to dampness, microbiological contamination or rodent and insect infestation etc. If certain raw materials require such controlled environmental conditions, the raw material stores may be subdivided with proper enclosures, to provide such conditions by suitable cabinization. While designing such containers, care must be taken to store raw materials like metallic origin, mineral origin, animal source, fresh herbs, dry herbs, volatile oils etc”. The earthen pot must be clean and a well-baked appropriate design shall be used. Since the processing of *Rasaushadhi* may introduce heavy

metal contamination, cross-contamination etc., cleaning of equipment is particularly important after every process, by using an appropriate cleaning agent which should not react with the material of equipment and must be free of unwanted properties.

World Health Organization WHO Technical Report Series, No. 902, 2002; Annex 9, the Guidelines on packaging for pharmaceutical products are given as:

- Protect against all adverse external influences that can alter the properties of the product, e.g. moisture, light, oxygen and temperature variations
- Protect against biological contamination
- Protect against physical damage
- Carry the correct information and identification of the product

The kind of packaging and the materials used must be chosen in such a way that:

- The packaging itself does not have an adverse effect on the product (e.g. through

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chemical reactions, leaching of packaging materials or absorption)

- The product does not have an adverse effect on the packaging, changing its properties or affecting its protective function.

The resulting requirements must be met throughout the whole of the intended shelf- life of the product. A container for pharmaceutical use is an article that holds or is intended to contain and protect a drug and is or may be in direct contact with it. The closure is a part of the container. The container and its closure must not interact physically or chemically with the substance in any way that would alter its quality.

Plastic Containers for medicines and Cosmetics:

Some plastics are designed especially for medicinal use and ensure the maintenance of product quality and wholesomeness. Plastic containers suitable for packing in drugstores are made of Polyethylene, Polystyrene, Polypropylene and Polyvinyl Chloride. Other plastics, pharmaceutically safe and suitable for specific substances are Polypropylene terephthalate and Polymethylmethacrylates.

In specific cases, where a container with a dispenser or certain characteristics of hospital use is required, plastic containers are custom designed and provide effective solutions which enable the implementation of new care therapies. In this context, the role of the technicians in the plastics industry who allow you to choose a specific product to the best packaging material that ensures the safety and efficacy of treatment information is noteworthy⁵⁸.

Food storage:

The safe storage of food for home use should strictly adhere to guidelines set out by reliable sources, such as the United States Department of Agriculture. These guidelines have been thoroughly researched by scientists to determine the best methods for reducing the real threat of food poisoning from unsafe food storage. It is also important to maintain proper kitchen hygiene, to reduce risks of bacteria or virus growth and food poisoning. The common food poisoning illnesses include Listeriosis, Mycotoxicosis, Salmonellosis, E. coli, Staphylococcal food poisoning and Botulism. Many other organisms can also cause food poisoning⁵⁹.

DISCUSSION

Storage or processing vessels are given prime importance as it enhances the shelf life of the material or it may incorporate necessary constituents into the formulation during the processing. The idea of enhancing the shelf life may be with respect to prevention of biological or chemical degradation of the components, prevention of alteration of the component, promoting the necessary chemical changes required, prevention of reaction between the materials stored and containers used or imbibing the chemical constituents during the preparation of a formulation.

The vessels/ containers can be used in three phases of preparation; storage of raw materials,

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processing and storage of final products. During storage of the raw materials the importance should be given to a *patra* owing to the reactivity of the container with the material. The material used for storage should not reduce the quality of the raw material; in turn it should prevent early degradation of the material or enhance the shelf life of the same. We also find the references where the containers render identification of genuine raw materials too. During the manufacturing phase, the prime idea of using a certain container is inert nature of the same with regards to the material in process. But in some instances the container used might impart its quality into the formulation which could be beneficial or it may alter or reduce the chemical components which in turn reduces the toxicity of the material. It may also serve as a better mode of size reduction, thermo- stability or liability and collection of product at the end of the procedure or any other useful manipulation of the formulation which has to occur during the period. Storage is an important entity which mainly concentrates on preserving the finished product without undergoing degradation for a stipulated period of time. In addition to this one can find various references where the storage material enhances the quality of the finished product which makes it therapeutically efficacious. Prevention of degradation by climatic factors is also one of the reasons for selecting a particular container for storage of certain materials. Standardization parameters used in ancient classical texts are more superior to the present

era. The vessel which is used to preserve raw drugs, during the process and end product preservation are mentioned. The term, "*Anuroopa Guna Bhajana*" indicates that the quality of the container must be similar to the content which is stored. Till date, in many places, mud pot and clothes are used to preserve raw drugs/ grains.

In some pharmaceutical processes, the particular container is used to enhance the quality of content or the product. For example, *Saraswatarista* is prepared in a gold container. Here the *medhya* property of *swarna* may be imparted in *Saraswatarista*. *Triphala* paste is applied on the iron container; *Triphala* can easily absorb iron and may deliver better *rasayana* property. The importance of containers is also seen in the preservation of end products like preservation of different *Anjana* in certain containers where it protects and enhances its property, as per the quality of containers used.

Not only in pharmaceutical preparations, but the role of the container is also applicable for processing of food and preservation. *Acharyas* have also highlighted precautionary aspects like preservation of ghee in copper vessels leading to poisonous property.

According to United States Department of Agriculture guidelines, thoroughly researched by scientists to determine the best methods for reducing the real threat of [food poisoning](#) from unsafe food storage⁶⁰, the oil preserved in plastic containers will get rancid. Therefore, once opened, oils should be refrigerated and used within a few weeks to avoid rancidity. Unopened

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oils can have a storage life of up to one year, but some types have a shorter shelf- life even when unopened (such as sesame and flax seed)⁶¹.

Similarly, the safety measures have been given importance in Good Manufacturing Practice (GMP) and WHO guidelines. As per GMP guidelines, the container must be compatible with the content. The requirements to be met by pharmaceutical packaging and packaging materials as described in compendia (Pharmacopoeias) and standards (e.g. those of the International Organization of Standardization) must be considered only as general in character. The suitability of packing material for any particular requirements and conditions can be ascertained through detailed packaging and stability studies on the product concerned. The container and the closure used must not interact (physically or chemically) with the substance which is preserved. So, before preserving the raw drug or the end product along with the shelf life of the product, one should study the compatibility of the product with the container. In *Ayurvedic* products, especially before preserving *Asava- Arishta* compatibility must be studied and used as alcoholic media can easily react with the container like plastic.

In olden days, the raw materials were preserved in clothes, mud pots and containers made of stone and metals. For decades, clay pots have been an inevitable part of the Indian culinary world. In many places, mud pots are used, because the alkaline nature of the clay neutralizes the acidic content and makes it safe⁶². Mud pots are prone

for breakage easily; metallic containers made of gold or silver are expensive which poses limitation for the usage of these containers. Metal containers enhance the quality of products stored in them, by incorporating mineral ions. For easy transportation and convenience, these containers are being replaced by plastic containers. The substance most commonly and widely used and most dangerous for human and environmental safety is plastic. They are non- biodegradable materials available in different compositions and qualities. The low quality of plastic is a great threat. The continuous use of plastics may result in cancer, skin diseases, ulcer, birth defects etc. Plastic bottles are made of polycarbonate plastic, a polymer made with the chemical Bisphenol A (BPA). Studies showed that BPA is a hormone-disrupting chemical that may cause reproductive abnormality and also precedes the development of diabetes. It also hampers the functioning of the immune system⁶³.

But plastic containers which are used in the pharmaceutical industry ensure the maintenance of product quality. A commonly used vessel in the kitchen is aluminium which is very cheap and easily handled. Aluminium in the body prevents the absorption of essential elements like Calcium, Zinc etc. and is also linked with Alzheimer's disease, Parkinson's disease and bone disease. Aluminium vessels must be avoided for acidic food preparation⁶³.

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CONCLUSION

- In the classics of *Ayurveda* one can find wide range of references on the containers. The article is an attempt to note down few of such references in a concise modus to highlight the importance of certain containers.
- The requirements to be met by pharmaceutical packaging and packaging materials as described in compendia (pharmacopoeias) and standards (e.g. those of the International Organization for Standardization (ISO) must be considered only as general in character. The suitability of packaging or packaging material for any particular requirements and conditions can only be ascertained through detailed packaging and stability studies on the product concerned.
- More precautions are needed for the preservation of *Asava- Arishta* and *Kshara* containing formulations; especially the formulation containing alkali, e.g. Cow's urine.

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