Developing A Herbal Preservative For Cadavers In Ayurvedic Anatomy- A Pilot Study

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Abstract-

Background: Preserving cadavers is crucial for anatomical studies, but traditional methods using chemicals such as formalin can have harmful properties. Ayurveda, like other sciences, lacks an alternative method for preservation. This study aimed to find a safe and effective herbal preservative for cadavers.

Aim: The aim of this study was to formulate an herbal preservative solution for human cadavers that ensures no risk of infection on contact, preservation of the body, and prevention of putrefaction changes and contamination with maggots and insects.

Objective: The objectives of the study were to identify natural preservative ingredients used in Ayurveda, research individual ingredients for their possible role as preservatives, and prepare and test an herbal solution on chicken muscle pieces.

Material and Methods: A detailed literature survey was conducted to identify natural preservative ingredients used in Ayurveda. The individual ingredients were researched for their possible role as preservatives. An herbal solution was prepared using the identified ingredients, and its efficacy was tested on chicken muscle pieces.

Results: The study identified natural preservative ingredients such as *Amalaka, Vibhitaki, Haritaki, Neemba* and *Vidanga*. These ingredients were found to have antimicrobial, antioxidant, and anti-inflammatory properties that could potentially preserve human cadavers. Tested herbal preservative solution on chicken muscle pieces at different concentrations. Preservation duration increased with higher concentration of solution. Maximum preservation period was achieved with 100% solution with no signs of contamination with maggots and insects.

Conclusion: This study provides a potential alternative to traditional chemical embalming methods and may enable Ayurvedic graduates to successfully practice medicine and surgery. To validate the effectiveness of the herbal solution on human cadavers, additional research is required. Moreover, in the main study, it is recommended to substitute certain drugs that could potentially enhance tissue preservation longevity in this solution.

Keywords: Ayurveda, Herbal Preservative, Visceral Preservation

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Introduction-

Acharya Sushruta, widely regarded as the father of Indian surgery, emphasized the importance of studying Rachana Sharir (Anatomy), which focuses on anatomy and dissection, as a fundamental subject in Ayurveda. The study of anatomy serves as the foundation for medical and surgical practice, and preserving human cadavers is crucial to enable Ayurveda graduates to successfully practice medicine and surgery. However, traditional methods of embalming using formalin, a chemical mixture of formaldehyde and water, pose significant risks to individuals who come into contact with the cadaver.

Formalin is a potent carcinogen, and exposure to it can lead to respiratory problems, skin irritation, and increased cancer risk. In addition, formalin can irritate the eyes, nose, and throat, and long-term exposure can cause severe health consequences. Given these concerns, there is an urgent need to develop safe and effective embalming fluids using alternative preservatives, particularly herbal ones.

Several other methods have been used to preserve cadavers, including:
Glutaraldehyde: This chemical is similar to formalin in its properties and is used as a disinfectant and preservative. However, it is also a potent irritant and can cause skin and respiratory problems, as well as headaches and dizziness.

Phenol: This chemical is a disinfectant, antiseptic and has been used in the past as an embalming fluid. However, it is also a potent irritant and can cause respiratory problems, skin irritation, and other health issues.

Ethanol: This alcohol-based solution can preserve tissues and is commonly used for the preservation of small animal specimens. However, it is not effective for the preservation of larger specimens and can cause tissue shrinkage and dehydration.

Sodium chloride: This salt solution is a natural preservative that can be used for short-term preservation of cadavers. However, it is not effective for long-term preservation and can cause tissue shrinkage and dehydration.

Despite these options, none of them have been widely adopted as a replacement for formalin in embalming human cadavers due to various reasons. Glutaraldehyde and phenol are toxic and irritant, just like formalin. Ethanol and sodium chloride are not effective for long-term preservation and can cause tissue shrinkage and dehydration. As such, exploring the use of herbal preservatives as a safe and effective alternative to traditional embalming methods is crucial.

In our research, we aimed to develop an herbal preservative solution for human cadavers that would ensure the safety of those who come into contact with the cadaver and prevent putrefaction changes that could lead to contamination with maggots and insects. Our research team is committed to exploring new ways of developing safe and effective herbal preservatives that can be used to embalm human cadavers.

The primary objective of our study was to develop an herbal preservative solution for human cadavers that ensures the safety of those who come into contact with the dead body while also maintaining the preservation of the body. Our specific objectives were to create a solution that would eliminate the fear and risk of infection on contact with the cadaver and prevent putrefaction changes that could lead to contamination with maggots and insects. The successful development of such a solution could have significant implications for the practice of medicine and surgery in Ayurveda, as it would provide a more natural and safe alternative to traditional and potentially harmful embalming methods. This approach could potentially reduce the risk of infection or harm to those who come into contact with the cadaver, while also ensuring that the body is preserved for medical and educational purposes.

In summary, our research on developing a safe and effective herbal preservative solution for human cadavers is a critical step towards an embalming method that is safe for those who

come into contact with cadavers. With the negative effects of formalin and other toxic preservatives, it is essential to explore new, innovative ways to preserve cadavers. Our research team is dedicated to finding alternative embalming methods, including using herbal preservatives, to improve the safety of individuals who come into contact with cadavers and maintain the integrity of the body for medical and educational purposes. The development of a successful herbal preservative solution could have significant implications for the field of Ayurveda and medicine, offering a natural, safe, and cost-effective alternative to traditional embalming methods. By working towards this goal, we hope to contribute to the advancement of medical knowledge while prioritizing the health and safety of everyone involved. [1]

Aim and Objective:

The aim of this study was to develop an herbal preservative solution for human cadavers. The objective was to create a solution that effectively prevents the risk of infection on contact with the deceased and ensures the preservation of the body. Additionally, the solution should prevent putrefaction changes and contamination with maggots and insects.

Material and Methods:

A detailed literature survey made in present study to find out the natural preservative ingredients that was used in Ayurveda, the search was extended to all literatures on print and digital media. The possible ingredients were listed out and the individual ingredients were researched in details for their possible role as preservatives.

Step1: Identification of Drugs-

All of the raw drugs are purchased from the Ayurvedic Pharmacy with an official invoice. Experts in botany provided authentication for all of the raw drugs. Figure one to eleven showing drugs that has been taken and Table 1 showing list of raw drugs.

Table 1 showing list of raw drugs:

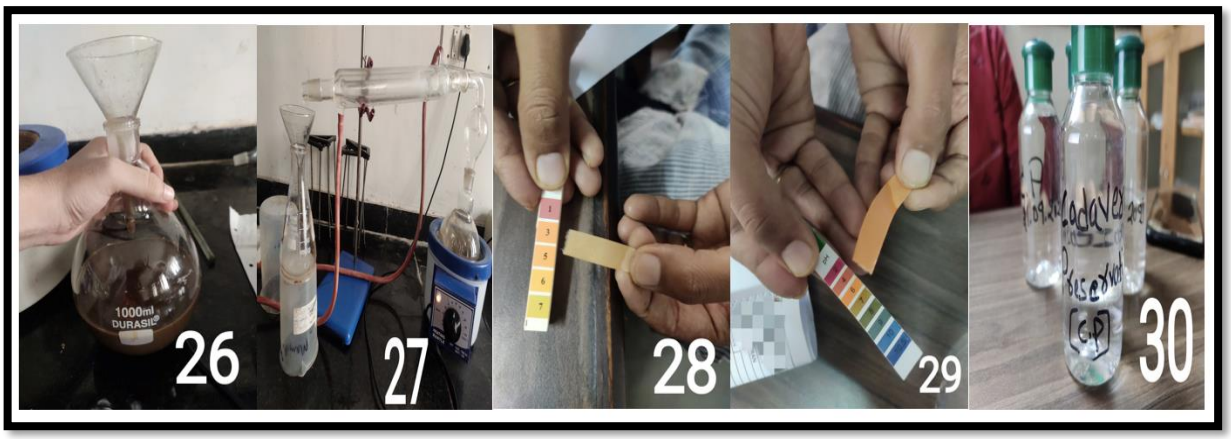
S. N.	Drugs	BotanicalName	*Parbhav*	*Projyang*
1	***Amalaka***	Emblica officinalisGaertn. [2-3]	Antioxidant	*Phala*
2	***Vibhitaki***	Terminalia belerica Roxb. [4]	Antioxidant	*Phala*
3	***Haritaki***	Terminalia chebula Retz [5-6-7]	Antioxidant	*Phala*
4	***Neemba***	Azadirachta indica, A. juss [22]	*Krimigahna*	*Tvaka* (Bark)
5	***Yavani***	Trachyspermumammi Linn. [8-9-10]	*Dhurganhnashasak,*	*Beeja*
6	***Vidanga***	Embelia ribesBurm [11-12]	*Krimigahna*	*Phala*
7	***Sarsapa***	Brassica campestris [13]	*Krimigahna,Sthambhana*	*Beeja*
8	***Lahsuna***	Allium sativumLinn.	Antibacterial,Antioxidant	*Kanda*
9	***Haridra***	Curcuma longaLinn. [14-15-18]	Antioxidant	*Kanda*
10	***Yashtimadhu***	Glycyrrhizaglabra Linn [16-17]	Antioxidant	*Moola*
11	***Tulsi***	Ocimum sanctum Linn. [19-20-21]	*Krimigahna,* Antioxidant	*Panchanga*

Step 2: Process of Preparation of *Kwath* (Decoction) and *Arishta* (Self-generated Alcohol) -

The raw drugs were subjected to coarse grinding, followed by the addition of eight volumes of water and subsequent boiling over low heat. After retaining one-quarter of the initial water, the mixture was taken off the heat and left to cool to lukewarm temperature. Next, it was filtered, and *Madhu* (honey) was added to it before storing it in a jar containing lid. To facilitate the fermentation process, one gm of yeast (For enhancing fermentation) were added to the filtered decoction. The storage jar was then sealed with a lid cap and secured with *Kapadmiti-Sandhibandh* using *Multani Mitti* and a piece of cotton cloth. The jar was then kept in a quiet location for 30 days to allow for fermentation.

After 30 days, the jar was opened, and the *Siddha Sandhana Laksana* was assessed to confirm the completion of the fermentation process. The *Praksepaka Dravyas* were completely submerged, and the fermented material possessed an alcoholic odor. No sound or effervescence was observed, and a burning candle continued to burn when brought near the fermenting media. These tests confirmed that the fermentation process was complete. The pH of the fermented decoction was then measured, and the resulting pH was found to be 4.0. Now moved to next step.

Step 3: *Arka* (Distillation Process)-
The fermented solution underwent distillation in the quality control laboratory, once the desired pH was attained. The resulting liquid was evaluated for various parameters including its appearance, odor, viscosity, pH etc.



Step 4: Six 100 ml Glass jars with plastic lids and Chicken muscle Pieces-
Two distinct experimental groups were formed - a Standard controlled group and a trial group - to investigate the impact of distilled solution ratios on chicken muscle pieces. In the Standard group, a chicken muscle piece was placed inside a glass jar containing 30ml of formalin solution. The jar was tightly sealed with an airtight lid, which had no pores, to ensure that the chicken muscle piece remained in a controlled environment.

In the trial group, five glass jars were used, each containing a chicken muscle piece, and five different ratios of distilled solution were added to each jar. These ratios included 10%, 25%, 50%, 75%, and 100% distilled solution. As with the Standard group, each jar was sealed tightly with an airtight lid, which had no pores, to prevent external factors from affecting the experiment.

The two groups were then placed in the Anatomy museum for a period of 15 days. On a daily basis, the appearance, chicken muscle piece condition, odor, viscosity, precipitation, and durability of the solutions were observed and recorded. To ensure the accuracy of the observations, photographs were taken of the solutions on a daily basis.

The collected data was then analyzed and compared to that of the Standard group to determine the impact of the different ratios of distilled solution on the chicken muscle pieces. The experiment provided valuable insights into the effects of varying distilled solution ratios and contributed significantly to the understand-ding of this field.

Results:

- The chicken muscle piece in the 10% fluid showed signs of waste on the third day, with the onset of foul odor and discoloration but no contamination with maggots and insects.
- The chicken muscle piece in the 25% fluid showed signs of waste on the fifth day, with the onset of foul odor and discoloration but no contamination with maggots and insects.
- The chicken muscle piece in the 50% fluid showed signs of waste on the ninth day, with the onset of foul odor and discoloration but no contamination with maggots and insects.
- The chicken muscle piece in the 75% fluid showed signs of waste on the twelfth day, with the onset of foul odor and discoloration but no contamination with maggots and insects.
- The chicken muscle piece in the 100% fluid showed signs of waste on the fifteenth day, with the onset of foul odor and discoloration but no contamination with maggots and insects.

By analyzing this data, we can see that the concentration of the distilled solution has a significant impact on the durability and freshness of the chicken muscle pieces. Lower concentrations (10% and 25%) resulted in waste within the first five days, while higher concentrations (75% and 100%) allowed for longer preservation, with signs of waste appearing on the twelfth and fifteenth days, respectively. The findings of this experiment can contribute to future research in this area and can be used to guide the selection of optimal concentrations for similar applications.

Discussion:

The practice of preserving tissues or cadavers involves the use of formalin solution, which is known to cause irritation and discomfort when inhaled. However, there is no safe alternative, the ancient text Sushruta Samhita suggests various methods of tissue preservation using different media such as fermented liquids, oils, salt, suspensions, herbal decoctions, and solutions. One such method involves using fermented decoctions of herbal drugs like *Triphala, Neemba, Yavani, and Vidanga*, etc which are filtered to remove residue and then distilled to obtain a transparent solution.

To evaluate the effectiveness of this method, a pilot study was conducted using chicken muscle tissue samples. The samples were placed in different concentrations of the distilled solution, ranging from 10% to 100%, and observed for fifteen days. The results showed that the degradation period increased with higher concentrations of the solution, with complete decay occurring after three days in the 10% concentration and fifteen days in the 100% concentration. However, this method did not meet the objective of preserving anatomical viscera for a longer period.

Future studies are required to enhance the preservation properties of this method and also to improve the properties of the preserved tissue. While formalin is currently the most widely used method for tissue preservation, this study highlights the potential for alternative methods using natural materials to be developed and tested for safety and efficacy.

Conclusion:

According to the study, the use of 100% fermented distillated solution resulted in the maximum tissue preservation period of fifteen days. These findings suggest that this method could be used as a suitable alternative to formalin for simple tissue sampling or collection processes. But, to ensure long-term preservation, it was necessary to make certain modifications to both the materials and methodology. Additionally, it was observed that replacing certain drugs with others could enhance the longevity of tissue preservation in this solution.

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