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Whole organ plastination using laboratory waste Thermocol (polystyrene)

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Abstract

Plastination is a technique to preserve bodies or body parts in biological science. Curable polymers used by plastination generally include silicone, epoxy resin and polyester-copolymer. In the present study 12-15 % solution made from Thermocol was used as plastination material. Organs like, brain, gizzard, liver, lungs, heart were collected and plastinated by this technique. The average shrinkage percentage was higher in softer tissue (brain) than the other plastinated tissues (heart, gizzard etc.). The colour of the most plastinated specimens remained normal except liver which altered slight lighter in color. The consistency of all the organs was hard but there was no change in morphological details.

Keywords: Plastination, Thermocol, waste

Introduction

The preservation and demonstration of anatomical specimens that retain much of their natural features has been a long-standing goal of anatomists, pathologists and other medical educators. Plastination is fundamentally, a technique of tissue preservation that was developed by Gunther von Hagens with the aim of obtaining a dry, odorless and a durable specimen. Curable polymers used by plastination generally include silicone, epoxy resin and polyester-copolymer. In the present study the wastes in the laboratory (Thermocol) were used to make polymer for plastination.

Materials and Methods

Animal organs including heart, spleen, brain, liver, and kidney were obtained from the local slaughter house of district Srinagar Jammu and Kashmir, India and processed as follows.

- Washing organs and limbs in running water to remove blood clots, meninges, unwanted tissues, and fat prior to further processing;
- Transferring the organs into a fixative solution containing 10% formal saline prior to dehydration and impregnation, said fixation ensuring tissue preservation, minimizing distortion, enhancing polymer infiltration, and improving quality and durability of plastinated specimens;
- Removing the organs from the fixative and washing thoroughly in running water;
- Placing the organs on flat support surfaces to ensure stabilization, maintain anatomical alignment, and prevent deformation during processing
- Immersing the organs in 100% acetone maintained at -15°C to -20°C
- A critical temperature-controlled condition that ensures precision and reproducibility of the method, for a period of approximately two weeks with intermittent replacement of acetone to achieve complete dehydration
- Preparing a plastination solution by dissolving expanded polystyrene (thermocol) in xylene at a concentration of 12–15% (w/v) to obtain a homogeneous resin;
- Impregnating the dehydrated organs in the plastination solution maintained at -20°C until the organs transition from a floating to a submerged state, thereby indicating completion of polymer infiltration and uniform resin penetration within the tissue matrix.
- Removing excess resin by wiping and allowing the organs to dry under ambient

conditions; and

- j) Curing the dried organs using a solution comprising alkyd resin and/or polyurethane in organic solvents with drying agents to provide surface sealing and durability.

Results

In the present study 12-15% thermocol solution was used as plastination solution. Heart, spleen, brain, liver, kidney and

many other organs were plastinated. The plastinated specimens were dry to touch, odorless, non-toxic, clean and non-fragile and portable (Figs. 1-5). Although shrinkage has occurred but it did not alter the morphology of the plastinated organs so as to be rejected out rightly from the point of anatomical studies (Table-1). Consistency of the plastinated tissues became hard after curing, there was no alteration in the texture of the plastinated samples.

Table: 1: Characteristics of organs before and after plastination

Before plastination						After plastination				
Organ	Size (cm)		Color	Consistency	% of shrinkage	Size (cm)		Color	Consistency	% of shrinkage
Heart of dog	10.2	6.5	Normal	Normal	Nil	9.8	6.2	Normal	Harder	8.2
Heart of fowl	2.3	1.4	Normal	Normal	Nil	2.1	1.2	Normal	Harder	7.2
Brain (sheep)	16	6	Normal	Normal	Nil	14	5	Normal	Harder	6.2
Liver of fowl (right lobe)	3.2	2.1	Normal	Normal	Nil	3.0	2.0	Changed	Harder	5.1
Liver of fowl (left lobe)	3.0	2.1	Normal	Normal	Nil	2.9	2.1	Changed	Harder	5.1

Discussion

Over the past 20 years, plastination has become an important means of preservation of organs, for well-dissected specimens or for body slices. In this process of preservation Silicone S10 is the gold standard in the preparation of plastinates (Wadood *et al.*, 2014) ^[4]. So far as plastination of organs is considered, some specific techniques of whole organ plastination, namely the P35 & P40 techniques have been found to give excellent results (Shahyar, 2010). Furthermore, sheet plastination of the organs produced more detailed, durable, and easier to handle specimens with 4 mm thickness by the P35 technique (Weber and Henry, 1992) ^[5]. The use of thermocol polymer for plastination in the present study produces appreciable results and an alternative polymer for impregnation. The physical characteristics such as color, size, consistency, percentage of shrinkage, and deformities in shape were studied before and after plastination of the specimens and the results were recorded. A 12-15 % solution made by dissolving thermocol in organic compounds like xylene proved an excellent source of solution for plastination. The average shrinkage percentage was higher in softer tissue (brain) than the other plastinated tissues (heart, gizzard etc.). Sora *et al.* (1999) ^[3] reported 4.4% (immersed at -25 °C) and 6.2% (impregnated at 5C°) shrinkage by using different immersion and impregnation conditions for human brains. Ali & Thnaian (2007) ^[1] described that shrinkage was remarkable in testis and kidney because of very fine tubules and the type of silicone used (S-10) may be not suitable to enter and fill the tubules, leading to shrinkage when cured. Being laboratory waste and a hazardous pollutant, thermocol responds very slowly to bacterial decomposition in the soil, thus making the soil infertile. It also releases poisonous gases on burning, which can cause respiratory problems. The use of thermocol for plastination reduces the hazardous pollution created by these wastes and will help to keep our environment pollution free.



Fig 1: Heart of dog



Fig 2: Heart of Fowl



Fig 3: Heart and lungs of rabbit

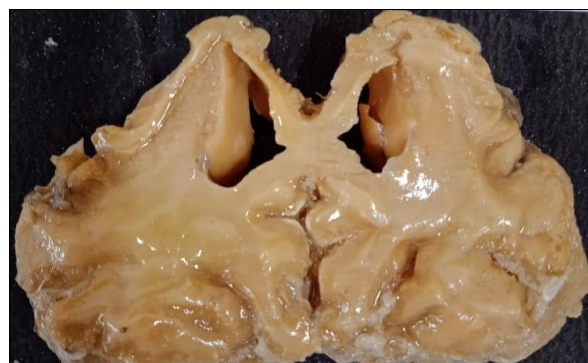


Fig 4: Brain of Sheep



Fig 5: Liver of Fowl

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Conflict of Interest

Not available

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Not available

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