

# Evaluate the bacterial and fungal growth on the biological tissues preserved by gum Arabic solutions

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DOI: 10.29322/IJSRP.10.03.2020.p9919

<http://dx.doi.org/10.29322/IJSRP.10.03.2020.p9919>

**Abstract:** Silicone-S10 plastination process is a modern technique used in preservation of biological tissues for long term and the preserved specimens are used in teaching gross anatomy for medical students, but it's relatively cost. In the previous study by Satte et al., in 2017, was used gum Arabic solutions as low cost materials in preservation of biological tissues, and the produced samples were maintained their anatomical features for the long-term. The current study was aimed to test the safety of tissues preserved in gum Arabic solution by evaluated the bacterial and fungal growth on the samples surfaces and compared with the same organs preserved in silicone-S10 as control. The study was conducted on 4 groups, each group contained 4brains, 4kidneys, and 4hearts. The first 3 organs from each group were obtained from gum Arabic solution preserved organs (test group), while the fourth organ from each group preserved by silicone-S10 as control group. Swab samples were taken from superficial and deep surfaces of each kidney, heart, and brain subsequently. Each sample was inoculated in different bacterial and fungal culture media then cultured in an incubator at 37 C<sup>0</sup> for overnight. The gum Arabic solutions preserved tissues revealed no bacterial and fungal growth as in control group. We concludes that; tissues preserved in gum Arabic solutions reveal no bacterial and fungal growth, and this indicated that the preserved specimen could be used as safe and inexpensive samples in teaching gross anatomy for medical students instead of costive silicone-S10 preserved tissues.

**Keywords:** gum Arabic, bacterial growth, biological tissues, fungal

## Introduction

Each year new medical students make their entry into the medical and veterinary colleges. The difficulty of obtaining fresh organs and tissues to study anatomy has encouraged the use of preserved ones. There are several methods for the preservation of biological tissues, which has helped a lot in the study of anatomy for medical and veterinary students and researchers. In ancient times, gum Arabic and some local materials such as natron and herbs were used traditionally by Egyptians to preserve cadavers.<sup>1</sup> Century's later, formalin solutions have been used for fixation of tissues, but formalin has health hazards such as watery eyes; burning sensations in the eyes, nose, and throat; coughing; wheezing; nausea; and skin irritation for students and staff during practical section.<sup>2</sup> Recently, plastination was introduced as a modern and safe technique for the preservation of cadavers by Von Hagens in 1979. During the plastination process, the tissues were fixed in formalin (5 to 20%), dehydrated in acetone, impregnated in curable silicone-S10 or epoxy resin and cured by silicone-S6. The silicones used in the plastination procedure are relatively expensive, not available and patented.<sup>3</sup> Gum Arabic solution components are the gum Arabic powder, glycerin, and distilled water, and these materials are available and safe.<sup>4</sup> Gum Arabic solutions were tested as an effective material for the biological tissue preservation process, and the produced specimens were maintaining their original anatomical features for the long-term.<sup>5</sup> This study aimed to evaluate the bacterial and fungal growth on the biological tissues preserved by gum Arabic solutions.

## Material and methods

A total of 12 organs of adult sheep were collected from biological tissues preserved in gum Arabic solutions and silicone-S10 for long-term (4years), in anatomy department, medical college, Najran University, KSA. These organs were divided into three groups namely, group 1, group 2, group 3; each group contains 4 brains, 4 kidneys, and 4 hearts respectively (Tables 1, 2, 3). The first three organs from each group were obtained from tissues preserved in three different concentrations of gum Arabic solutions as test groups, while the fourth one organ from each group was obtained from tissues preserved in silicone-S10 as control group.

Swab Sample was taken from each one of the above preserved biological tissues (from superficial and deep surfaces), and each swab taken was labeled (Tables 1, 2, 3). The swab samples were inoculated in different bacterial and fungal culture media such as blood agar, macConkey agar and sabroutes dextrose agar. The sample cultured in an aerobic incubator at 37C<sup>0</sup> for 24 hours, and then the samples were examined regarded to bacterial and fungal growth on the superficial and deep surfaces of each preserved organ.

**Table 1:** Brains and their preservative solutions and the swab sample labels.

Samples	Concentration of gum g/L	Glycerin %	Swab Labels
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Brain 1	227	10	001S
			001D
Brain 2	100	85	002S
			002D
Brain 3	50	80	003S
			003D
Brain 4	Control solution (silicone-S10)		00C1S
			00C1D

S= swab sample from superficial surface of the brain, D= swab sample from deep of the brain

**Table 2:** Kidneys and their preservative solutions and the swab sample labels.

Samples	Concentration of gum g/L	Glycerin %	Swab Labels
Kidney 1	227	10	004S
			004D
Kidney 2	100	85	005S
			005D
Kidney 3	50	80	006S
			006D
Kidney 4	Control solution (silicone-S10)		00C2S
			00C2D

S= swab sample from superficial surface of the kidney, D= swab sample from deep part of the brain

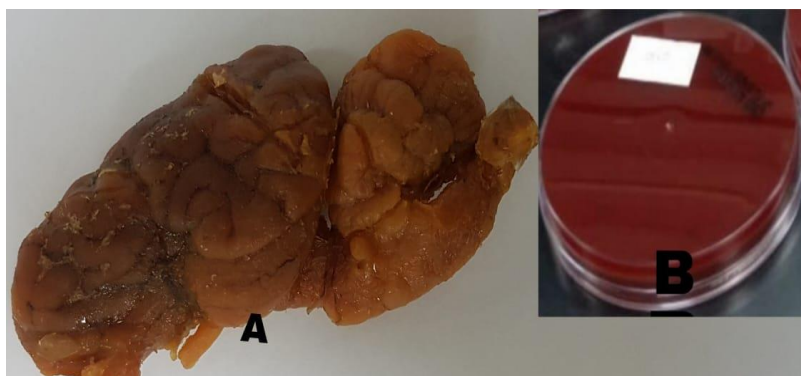
**Table 3:** Hearts and their preservative solutions, and the swab sample labels.

Sample	Concentration of gum g/L	Glycerin %	Swab Labels
Heart 1	227	10	007S
			007D
Heart 2	100	85	008S
			008D
Heart 3	50	80	009S
			009D
Heart 4	Control solution (silicone-S10)		00C3S
			00C3D

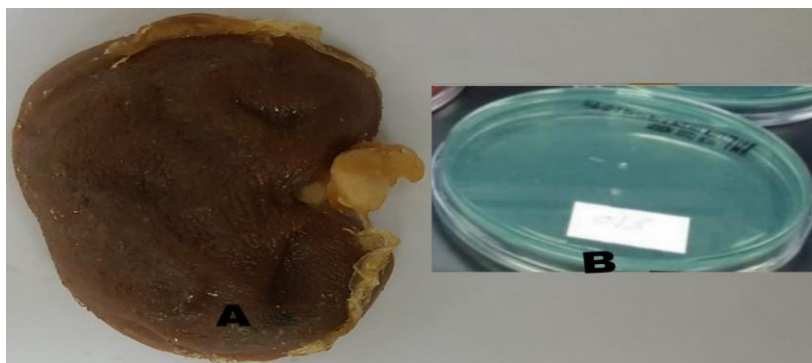
S= swab sample from superficial surface of the hearts, D= swab sample from deep part of the brain

**Results:**

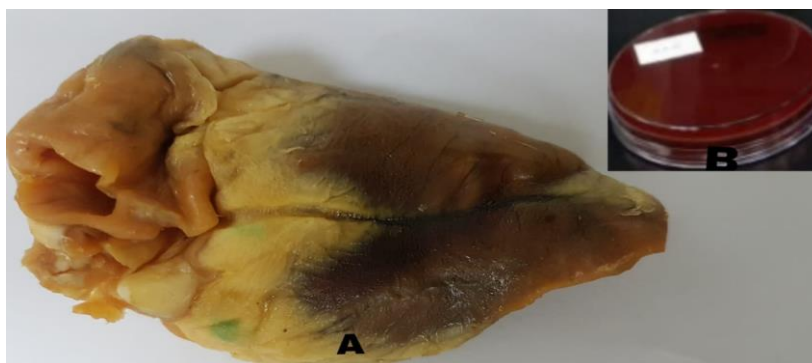
The preserved brains, kidneys and hearts in gum Arabic solutions showed no bacterial and fungal growth on their superficial and deep surfaces, and they are similar to those obtained from the same organs plastinated in silicone-S10 (Figures 1, 2, 3).



**Figure 1:** preserved Brain in gum Arabic solutions (A) and their bacterial and fungal culture (B), showed no bacterial and fungal growth.



**Figure 2:** preserved Kidney in Gum Arabic solutions (A) and their bacterial and fungal culture (B), showed no bacterial and fungal growth.



**Figure 3:** preserved Heart in Gum Arabic solutions (A) and their bacterial and fungal culture (B), showed no bacterial and fungal growth.

#### **Discussion:**

In this study, the preserved specimens in gum Arabic solutions are showed no bacterial and fungal growth on their deep and superficial surfaces after stored on shelves at room temperature for 4 years ago. During gum Arabic solutions preservation process, the force impregnation was used to infiltrate the gum Arabic solution within the tissue samples (kidney, heart and brain) and the content of gum Arabic solution were included: the gum Arabic powder, glycerine, and distilled water.<sup>5</sup> In the current study we put the real reason of absent bacterial and fungal growths on the surfaces of specimens is due to use the gum Arabic solutions in preservation process.

The gum Arabic and glycerine are act as antibacterial growth as records by authors: Gum Arabic in ancient Egypt was used to determine their effectiveness in the preservation of the dead bodies and it's shown has anti-bacterial properties that protected the body from microbial attack.<sup>6</sup> Gum Arabic is used in food and pharmaceutical industries as an emulsifier and long term stabilizer.<sup>7</sup> Investigators revealed that the gum Arabic solution is having great power against microbial (Alkarib et al., 2016; Gayed & Hasan, 1966; Bnuyan et al., 2015; Al Alawi et al., 2018; Mohamed et al., 2014).<sup>8, 9, 10, 11, 12</sup> Thus, all that the authors mentioned is consistent with our results, which the presence of gum Arabic in preservative solution prevented the bacterial and fungal growth on the samples surfaces. Although, in this study, glycerine was the one of the contents of preservative solution and this act as antibacterial agent as mentioned in previous study showed that the glycerine acted as antibiotic.<sup>13</sup>

#### **Conclusion:**

Biological tissues preserved by gum Arabic solutions for long-term showed no bacterial and fungal growth on their surfaces and the produced specimens can be use as safe and inexpensive samples in teaching gross anatomy in medical and veterinary colleges.

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