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Preparation of Internal Genital Organs of Adult Cows by S10B Silicone Plastination Method

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Abstract: It is essential to demonstrate organs and their structures practically in anatomy education. Plastination is an anatomical technique that has been used to prepare biological specimens for educational purposes. it is a gradual process by replacement of fluids in biological tissues with reactive polymers such as silicone, epoxy or polyester resin. This study was aimed to plastinate the internal genital organs of adult cows by S10B silicone plastination method. Ten internal genital organs of cows were plastinated to be used in veterinary undergraduate teaching/practices. After dissection and fixation, the specimens were plastinated with S10B plastination method and colour differentiation of the organ parts were measured. The plastination process was completed with dehydration, defatting, impregnation, and gas curing stages, respectively. It was observed that the plastination of specimens with S10B plastination method preserve normal anatomy of genital organs. It was estimated that all parts of uterus became greenish and bluish colour and the value of the brightness of uterus was increased. The tissue shrinkage was reduced considerably when dehydration was carried out in a cold environment. It was concluded that S10B plastination method can be easily used to prepare the specimens of genital organs to be used in veterinary teaching.

Keywords: Anatomy, Female genital organs, Gynaecology, S10B silicone plastination.

S10B Silikon Plastinasyon Yöntemi ile Erişkin İneklerin İç Genital Organlarının Hazırlanması

Öz: Anatomi eğitimi sırasında, organları ve bu organların yapılarını uygulamalı olarak göstermek oldukça önemlidir. Plastinasyon, biyolojik örneklerin eğitim amacı ile hazırlanılarak kullanılmakta olan anatomik bir tekniktir. Biyolojik dokulardaki sıvıların silikon, epoksi veya polyester reçine gibi reaktif polimerler ile değiştirilmesi sonucunda gerçekleşen aşamalı bir işlemdir. Bu çalışmada, yetişkin ineklerin iç genital organlarının S10B silikon plastinasyon yöntemi ile plastine edilmesi amaçlanmıştır. Veteriner hekimlik lisans öğretimi ve uygulamalarında kullanılmak üzere 10 adet ineğe ait iç genital organlar plastine edildi. Diseksiyon ve tespit işleminden sonra, örneklere S10B plastinasyon yönteminin diğer önemli aşamaları uygulandı ve organ bölümlerine ait renk değişimleri kantitatif olarak hesaplandı. Plastinasyon işlemleri sırasıyla, dehidrasyon, yağdan arındırma, zorla impregnasyon ve gazla kürleme - sertleştirme aşamaları ile tamamlandı. S10B plastinasyon yöntemi ile plastine edilen örneklerin normal anatomik yapısını koruduğu gözlendi. Uterus'a ait tüm bölümlerin yeşilimsi ve mavimsi bir renk haline geldiği ve uterus'un parlaklık değerinin arttığı belirlendi. Soğuk ortamda dehidrasyon gerçekleştirilmesi ile doku büzüşmesi önemli ölçüde azaldığı belirlendi. Veteriner hekimlik eğitiminde kullanılacak olan genital organ örneklerini hazırlamak için S10B plastinasyon yönteminin kolaylıkla kullanılabileceği sonucuna varıldı.

Anahtar Kelimeler: Anatomi, Dişi genital organlar, Jinekoloji, S10B silikon plastinasyon.

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INTRODUCTION

Consideration of reproductive performance of animal is important in veterinary science as it affects the economy of country. Seeing the importance of reproduction, researches are focused on reproductive organs of large ruminants. Clinicians or technicians may encounter various complications because of insufficient clinical or anatomical knowledge of reproductive organs during performing the artificial insemination in animals (1). It is essential to demonstrate organs and its structures practically in anatomy education. In these fields, dissected cadavers are necessary but recent years modern techniques have come front (2). Moreover, formaldehyde, which is frequently used in the fixation of tissues and organs in anatomy education, is highly harmful to human health (3). At that point plastination, the most advanced and modern anatomical technique to prepare nature-identical specimens may be useful and effective than the classical methods (3,4).

Plastination is an anatomical technique that has been frequently used to prepare biological specimens for educational purposes (5,6). This technique was firstly introduced by Professor Gunther von Hagens at the University of Heidelberg in 1977 (7,8,9). Plastination is a gradual process based on the long-term preservation of tissues by replacement of fluids in biological tissues with reactive polymers such as silicone, epoxy or polyester resin (10,11). Plastination is used for conservation of biological tissues (whole body, brain, liver, lungs, kidney, heart, muscles, joints, complex cadavers or sections of certain areas, etc.) for years without deformation. The tissue becomes dry and non-hazardous by the help of different polymers (7,12). Specimens, prepared with this technique, are elastic, durable, odourless, nature-identical and non-hazardous (13,14). Due to these properties, many anatomists prefer plastination method instead of other preservation methods. In addition, many studies have indicated that plastinated specimens are convenient for education and can meet the expectations of students (15). Plastinates have already being used for better understanding and comprehension of various anatomic structures in anatomy. Furthermore, plastinates might play an extremely active role in clinics especially focused on obstetrics-gynaecology and artificial insemination (4,16).

The study was carried out to prepare the nature-identical specimen of female genital organs for the use in teaching of artificial insemination and obstetrics courses. The study was also helpful to standardize the silicone plastination protocols for the preparation of anatomical specimens of female genital organs.

MATERIALS and METHODS

Internal genital organs of 10 adult Holstein cows were obtained from the slaughterhouse. The study was approved by Ankara University Animal Experiments Local Ethics Committee (Decision no: 2017-13-107). The organs were carefully dissected and fixed in 4% formalin solution for 10 days. The dehydration was carried out at -20 °C with 99.5% acetone bath. Three consecutive changes were given in acetone. The mass ratio of the acetone to the organs was kept 10:1. The concentration of acetone was monitored in each change. In the last change of acetone, the acetone concentration was 99.1%. After complete dehydration, the organs were defatted using pure acetone for 5 days at room temperature. Subsequently, forced impregnation was carried out in a vacuum tank at -20 °C using S10B silicone polymer and S3 catalyser. The ratio of silicone polymer and catalyser was 100:1. Complete impregnation of genital organs was monitored by observing the acetone bubbles on the surface of silicone filled vacuum tank. When the impregnation was completed, no bubbles were observed on the surface of silicone. Finally, the gas curing was done with S6 for hardening of specimens. The final products were stored in dehumidified air-tight bags (Fig. 1).

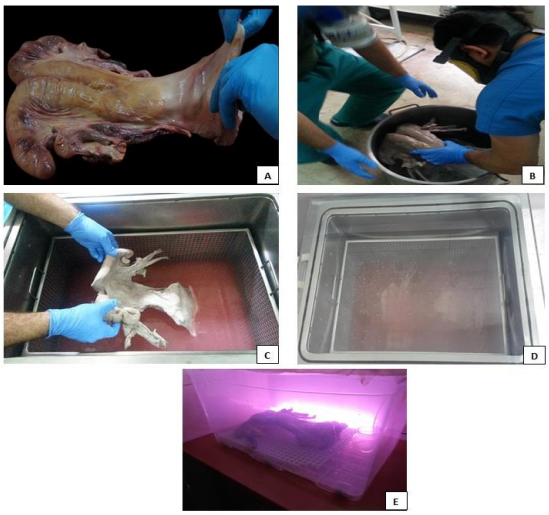

Figure 1. Different stages of silicone plastination method: dissection and preparation of specimens for fixation (A), dehydration stage (B), forced impregnation stage (C), the acetone bubbles that appear on the surface of the silicone polymer in the vacuum tank (D), gas curing and hardening stage (E).
Şekil 1. Silikon plastinasyon yönteminin farklı aşamaları: örneklerin diseksiyon ve fiksasyona hazırlanması (A), dehidrasyon aşaması (B), zorlu impregnasyon aşaması (C), vakum tankındaki silikon polimeri yüzeyinde gözüken aseton kabarcıkları (D), gaz kürleme ve sertleştirme aşaması (E).

The colour differentiation of the parts of the uterus (uterine horn, body and cervix) was measured using the CR-400 Minolta portable colorimeter (The Konica Minolta Chroma Meter CR-400, Tokyo, Japan). Colour alterations were quantitatively evaluated using the colour data software (SpectraMagic NX, Tokyo, Japan). The colour measurements were performed on fresh organs and their plastinated samples. The brightness (dL), the change between the blue and yellow colour (da) and the change between green and red colour (db) were evaluated.

RESULTS

In this study the specimens of internal genital organs of adult Holstein cows were prepared by silicone (S10B) plastination method for the use in anatomy teaching and clinical courses. These specimens retained their natural anatomical structures (Fig. 2). For complete dehydration 3 consecutive changes were given in acetone bath. When the dehydration was carried out at low temperature, the shrinkage of tissues was considerably reduced. Defatting process increased the quality of the final product, by reducing the fat surrounding the local vessels and nerves. The quantitative data of the differentiation of the specimen colours were given in Table 1. Additionally, the colour differentiation scale of one of the uterus was indicated in Figure 3.

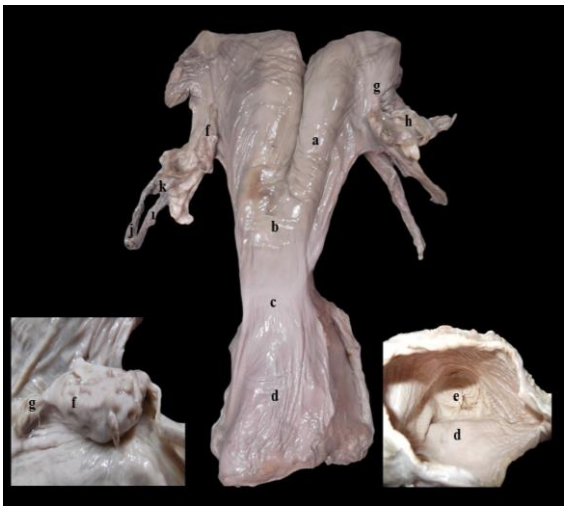

Figure 2. Plastinated internal genital organs of cows; uterine horn (a), uterine body (b), cervix (c), vagina (d), external orifice (e), ovary (f), ovarian ligament (g), ovarian bursa (h), ovarian artery (i), ovarian vein (j), suspensory ligament of ovary (k)
Şekil 2. İneklerin plastine edilmiş iç genital organları; cornu uteri (a), corpus uteri (b), cervix uteri (c), vagina (d), ostium uteri externum (e), ovarium (f), ligamentum ovari (g), bursa ovarica (h), a. ovarica (i), v. ovarica (j), ligamentum suspensorium ovari (k)

Table 1. The mean and standard deviation values of the colour differentiation measurements of the parts of the uterus.
Tablo 1. Uterus bölümlerinin renk farklılaşma ölçümlerinin ortalama ve standart sapma değerleri.

Measurement	Uterine Horn	Uterine Body	Cervix
dL	6.45 ± 1.4	7.45 ± 2.86	10.38 ± 1.64
da	-6.39 ± 1.81	-7.32 ± 1.48	-8.13 ± 1.42
db	-4 ± 1.9	-6.24 ± 3.22	-5.23 ± 2.04

dL: the brightness; da: the change between the blue and yellow colour; db: the change between green and red colour.

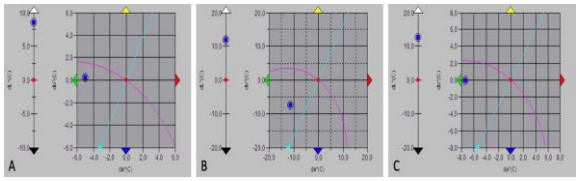

Figure 3. The colour differentiation scale figures of the parts of the uterus; A: Uterine horn, B: Uterine body, C: Cervix.
Şekil 3. Uterus bölümlerine ait renk değişim skalası; A: Cornu uteri, B: Corpus uteri, C: Cervix uteri.

DISCUSSION and CONCLUSION

Although it has been stated that the fixation of tissue in Kaiserling I solution preserves the natural colour of the organ (4,17), in this study the change of the specimen colour was evaluated with the use of pigmented silicone polymer and regular formaldehyde fixation. It was estimated that all parts of the uterus became greenish and bluish colour. The value of the brightness of the uterus was increased. The colour differentiation of the uterine horn was much less than other parts.

The acetone bath at cold temperature instead of room temperature was helpful to reduce the shrinkage of final product (12,18). Ekim et al. (19,20) reported that defatting process after dehydration increased the quality of the final product. Sivagnanam et al. (4,17) reported that the use of polyester or epoxy resin for the impregnation instead of silicone polymer would reduce the cost. But the use of silicone polymer reduces the shrinkage of tissue; maintain the natural colour and anatomy, thus make the better quality of specimens. Although silicone polymer is more expensive, it was observed that the chemicals of the plastination process did not lose their properties and can be used in the future applications. Suganthy and Francis (12) were stated that silicone polymer is an efficient chemical that causes minimum loss per sample.

In the previous studies (13,14), it has been indicated that the plastinated specimens were odourless, elastic, durable and harmless for human health. It is thought that plastinated samples prepared in this study had the same features. However, we plan to carry out some quantitative analysis of the plastinated samples about their elasticity and durability qualities in future studies.

Consequently, it is concluded that the specimens prepared by silicone plastination method can be used as an alternative to fresh organs/tissues in anatomy and clinical educations. It is thought that the protocols defined in this study may be reference to plastination studies on the mammal genital organs to be performed in future.

Conflict of interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Thibier M., Wagner HG., 2002. World statistics for artificial insemination in cattle. Livest Prod Sci, 74, 203-212.
2. Oto C., Bakici C., Insal B., Yilmaz B., Ozen D., 2018. Evaluation of the acceptability of fresh dog cadavers in anatomy education. Indian J Anim Res, 808, 1-5.
3. Ramos ML., De Paula TAR., Zerlotini MF., Silva VHD., Carazo LB., De Paula MF., Silva FFR., Santana ML., Silva LC., Ferreira LBC., 2018. A comparison of different de-plastination methodologies for preparing histological sections of material plastinated with Biodur® S10/S3. J Int Soc Plastination, 30, 10-15.
4. Sivagnanam S., Balasundaram K., Selvaraju M., Ravikumar K., Kumaravel A., Paramasivan S., 2014. The polyester resin plastination as a tool for making permanent dry specimens for teaching gynaecology. AJST, 5, 185-186.
5. Riederer BM., 2014. Plastination and its importance in teaching anatomy. Critical points for long-term preservation of human tissue. J Anat, 224, 309-315.
6. Estai M., Bunt S., 2016. Best teaching practices in anatomy education: A critical review. Ann Anat, 208, 151-157.

7. Ottone NE., Cirigliano V., Bianchi HF., Medan CD., Algieri RD., Brum GB., Fuentes R., 2015. New contributions to the development of a plastination technique at room temperature with silicone. Anat Sci Int, 90, 126-135.
8. Ottone NE., Del Sol M., Fuentes R., 2016. Report on a sheet plastination technique using commercial epoxy resin. Int J Morphol, 34, 1039-1043.
9. Ottone NE., Vargas CA., Veuthey C., Del Sol M., Fuentes, R., 2018. Epoxy sheet plastination on a rabbit head–new faster protocol with Biodur® E12/E1. Int J Morphol, 36, 441-446.
10. Steinke H., Rabi S., Saito T., Sawutti A., Miyaki T., Itoh M., Spanel-Borowski K., 2008. Light-weight plastination. Ann Anat, 190, 428-431.
11. Pashaei S., 2010. A brief review on the history, methods and applications of plastination. Int J Morphol, 28, 1075-1079.
12. Suganthy J., Francis DV., 2012. Plastination using standard S10 technique-Our experience in Christian Medical Collage, Vellore. J Anat Soc India, 61, 44-47.
13. Kumro SL., Crocker AV., Powell RL., 2013. Injection plastination: A low-tech, inexpensive method for silicone preservation of small vertebrates. J Int Soc Plastination, 25, 12-17.
14. Gonzalvez M., Ortiz J., Latorre R., 2017. S10 Plastination technique for preservation of parasites: the case of Oestrus ovis larvae. J Int Soc Plastination, 29, 5-10.
15. Latorre RM., Garcia-Sanz MP., Moreno M., Hernandez F., Gil F., Lopez O., Ayala MD., Ramirez G., Vazquez JM., Arencibia A., Henry RW., 2011. How useful is plastination in learning anatomy? JVME, 34, 172-176.
16. Chapman SJ., Hakeem AR., Marangoni G., Prasad KR., 2013. Anatomy in medical education: Perceptions of undergraduate medical students. Ann Anat, 195, 409-414.
17. Sivagnanam S., Balasundaram K., Selvaraju M., Ravikumar K., Kumaravel A., Paramasivan S., 2014. The epoxy resin plastination of reproductive organs of animals. AJST, 5, 181-182.
18. Brown MA., Reed RB., Henry RW., 2002. Effects of dehydration mediums and temperature on total dehydration time and tissue shrinkage. J Int Soc Plastination, 17, 28-33.
19. Ekim O., İnsal B., Bakıcı C., Hazıroğlu RM., Akgün RO., 2014a. Yılanlarda Soğuk Ortam Tekniği ile Tüm Vücut Silikon Plastinasyonu. Dicle Üniv Vet Fak Derg, 1, 1-14.
20. Ekim O., Tunalı S., Hazıroğlu RM., Ayvalı M., 2014. Evcil memeli hayvanlarda böbreklerin soğuk ortam tekniği ile silikon plastinasyonu. Vet Hekim Der Derg, 85, 1-11.