Plastination Technology for Biomedical Research and Studies in Kenya

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Abstract

This paper reports a descriptive survey carried out on the present methods of preservation of biological tissues and awareness of plastination, as a method of preservation. The study was carried out amongst 100 biomedical scientists randomly sampled from two (2) teaching and two (2) research institutions, the National Museum, two (2) private and one (1) public National hospital in Kenya. It was found that conventional methods such as fixation by immersion (70%); and embalming (26%) with formaldehyde and or gluteraldehyde were commonly used for long term preservation of tissues in these institutions. These methods were found to be less costly, easy to use and the only method(s) available even though they pose some hazards. The study found that 85% of the respondents did not know anything about plastination while 11 % were aware of it, and 4% did not respond. The advocacy of preservation of tissues by plastination has been gradual in developed countries. About 50% recommended the use of plastination in Kenya. However, the extent to which it may make an impact in the developing countries appears to depend on cost effectiveness and feasibility of implementation, as well as provision for training of personnel.

Introduction

Kenya is a developing country in Africa, and to date the preservation of biological tissues is done by conventional methods such as perfusion and embalming. The chemicals commonly used are formaldehyde and gluteraldehyde which are known to be toxic (Norman, 1986). In these methods the penetration of chemicals into deeper parts of the organ or body depends on the flow of fixatives by perfusion pressure through blood vessels (Logan, 1983). If tissues are well perfused the cells are fixed in situ. Tissues are also preserved by immersion whereby they may be kept in the fixatives for long preservation. The fixatives used poses some hazards to the users (Pabst, 1987).

Plastination is a unique technique of preservation developed by Gunther von Hagens in 1978 (von Hagens, 1979-1984, 1985; von Hagens et al., 1987) . In this method water and lipids in biological tissues are replaced by a polymer such as silicone, epoxy or polyester, which are subsequently hardened resulting in dry, ordorless and durable specimens. The class of polymer used determines the optical and mechanical properties of impregnated specimens (Weiglein, 1996, 1997).

The available information in the literature on plastination is scanty and the method appears to have been used recently in America and Europe (Weiglein, 1997; Cook, 1997). The present study therefore aims at ascertaining the methods of preservation used presently in biomedical institutions and the awareness as well as knowledge on plastination method amongst the Kenyan scientists.

Materials and Methods

The survey was carried out to review the methods of preservation of tissues and awareness of plastination method. The specific objectives were:

1. To determine the method(s) of tissues preservation in Kenya.
2. To establish the reasons for using these method(s).
3. To establish the hazards associated to the method(s) of preservation used.
4. To determine the awareness of plastination method of preserving tissues.
5. To determine the advocacy of plastination method.

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A sample of 100 subjects [Veterinary Anatomist (Vet), Zoologists (Zoo), Human Anatomists / Histologists (Anat/ Histo), Pathologists (Path), Scientists and/or Lecturers (Lect), Laboratory Technicians (Tech) and Botanists (Bot)] were selected from the following biomedical institutions around and within the city of Nairobi (table 1):

A - Two (2) Teaching Institutions:
i) University of Nairobi (UON) (University)
ii) Kenya Medical Training College (KMTC) (Middle level training college)

B - Two (2) Research Institutions:
i) Kenya Medical Research Institute (KEMRI)
ii) International Livestock Research Institute (ILRI)

C - **Three (3) Hospitals:**
i) Kenyatta National Hospital (National Public Hospital) ii) Two (2) Private Hospitals:
a) Nairobi Hospital
b) Aga Khan Hospital

D - Kenya National Museum

Detailed questionnaires (table 2) were designed and distributed to the subjects, in the above institutions, and were collected by the researcher.

The questionnaires covered the following issues:

1. The kinds of method(s) used in preservation of tissues in their departments.
2. The reasons for using the above method(s).
3. The chemicals used in these method(s).
4. The hazards involved in the used method(s).
5. The awareness of plastination.
6. The use of plastination.
7. Advantages and disadvantages of plastination.
8. The advocacy of plastination, as a method of preservation of tissues.

The data was analysed using SPSS Version 7.5 Computer program, and frequencies were obtained for the various objectives.

Table 1. Distribution of the sample

INSTITUTION	RESPONDENTS							
	Vet	Zoo	Anat/Histo	Path	Lect	Tech	Bot	TOT.
A. Teaching Institutions i)UON ii) KMTC	4	6	6 5		4 15	4	6	30 20
B. Research Institutions KEMRI ILRI		1	2	3	1 5	1		5 8
C. Hospitals Kenyatta Nat. Hospital Nairobi Hospital Aga Khan Hospital			5 2 2	(Chief) 1 (Chief) 1	10	5 1		21 3 3
D. Museum Depts. Mammology Ornithology Herpetology Genetic	1	2	1		1 2	1 2		4 3 2 1
TOTAL								100

Table 2. Research questionnaire

Q la. Of the following material preservation method(s) which one(s) do you usually employ. (Tick off the one you use)

A Embalming by perfusion
B Fixation by immersion
C Drying: Sunshine
Salt
Charcoal
Oven
Others (Please indicate)

D Freezing □
E Plastination □
F Taxidermy □
G None of the above □

Qlb. Why do you use this method(s)

A They are not costly □
B Easy to use □
C Materials used in the methods are easily available □
D No hazards involved □

Q 2. Of the following methods which one(s) are you NOT conversant with

A Embalming by perfusion
B Fixation
C Drying
D Freezing

E Plastination □
F Taxidermy □
G All of the above □

Q 3a. What are some of the chemical materials used in the preservation method(s) that you have indicated

A Polymer
B Alcohol
C Acetone

D Formaldehyde □
E Gluteraldeyhde □
F Others (Please indicate)

Q 3b. How long do you preserve your tissue using this method(s) before replacing them (Match the methods and the frequency of replacement)

Embalming by perfusion	☐	A Daily
Freezing	☐	B Weekly
Plastination	☐	C Monthly
Taxidermy	☐	D Yearly
Drying	☐	E 5 Yearly
Fixation by immersion	☐	F Over 10 years

Table 2. Research questionnaire (continued)

Q 4. Match the following dangers you perceive as inherent to the method(s) that you have indicated

Methods	**Types of Danger**
Freezing	A Irritation
Plastination	B Burning
Taxidermy	C Choking
Embalming by perfusion	D Intoxication
Drying	E Scalding
Fixation by immersion	F Trauma
	Others _____

Q5. Are you aware of plastination as a method of preservation? Yes □ No □

Q 6. If your answer is yes, how often have you used it?

Routinely □ Occasionaly □ Rarely □ Never □

Q 7. What types of polymers do you employ in plastination?

Silicone □ Epoxy □ Polyester □

Others (please indicate) _____

Q 8. What advantages are there in plastination?

_____

Q 9. What disadvantages are associated with plastination?

_____

Plastination is a unique technique of tissue preservation. In this process, water and liquids in biological tissues are replaced by curable polymers (silicone, epoxy, polyester) which are subsequently hardened resulting in dry, odourless and durable specimens. The class of polymer used determines the optical (transparent or opaque) and mechanical (flexible or firm) properties of the impregnated specimen.

Q 10. Would you recommend plastination as a method of preservation?

Highly recommend □ Recommend □ Not recommend □ Q

11. What limitations have you encountered in plastination?

_____

Q12. How would you rate plastination in regard to financial implications for both materials and equipment

Very expensive □ Expensive □ Reasonable □ Not expensive □

Results

100 Scientists namely Human and Veterinary Anatomists, Zoologists, Pathologists, Botanists, Laboratory Technicians, Lecturers, Histologists from Biomedical institutions were involved in the study.

The study shows that the methods of tissue preservation most commonly used were fixation by immersion (70%) followed by embalming and perfusion (26%). The other methods were more rarely used, the least being dehydration (2%) (table 3).

Table 3. The methods used for preservation of tissues

METHOD	FREQUENCY
Fixation by immersion	70%
Embalming and perfusion	26%
Freezing	20%
Drying by oven	12%
Taxidermy	10%
Drying by charcoal	6%
Dehydration	2%

n=100

Most of the participants to the study declared that they were using their methods because they were easy to use (35%), less costly (26%) or they had no other method available (table 4).

Table 4. Reasons given for the use of conventional methods

REASONS	FREQUENCY
Easy to use	35%
Not costly	26%
Materials are available	23%
The only choice	24%
No hazards	10%

n=100

The study also established that the most commonly used chemicals are formaldehyde (72%), alcohol (64%) and gluteraldehyde (37%) (table 5).

Some of these chemicals such as ethanol, acetone and borax are used in combination with others such as formaldehyde, as no fixative is considered complete by itself.

Table 5. Chemicals used in preservation methods

CHEMICALS	FREQUENCY
Formaldehyde	72%
Alcohol	64%
Gluteraldehyde	37%
Acetone	9%
Borax	10%
Others (e.g. phenol)	23%

n=100

The survey shows that the methods used for preservation of tissues pose some hazards, for instance the respondents using fixation by immersion complained of irritation (50%), self fixing (32%), intoxication (6%) and itching (20%). Those using embalming and perfusion also complained of irritation (18%) and intoxication (6%) (table 6).

The results show that 89% of the participants in the study did not have any knowledge about plastination while 11% were aware of plastination.

About 66% of the population highly recommended (16%) or recommended (50%) plastination as a method of preservation while 22% did not. Twelve percent did not respond to this question.

Discussion and Conclusions

For long term preservation of tissues in Kenya, conventional methods are used because they are easy, economical and moreover the only choice of preservation methods available.

The study showed that awareness of plastination method was very low (11%) amongst the Kenyan scientists. This method is not presently used in biomedical and research institutions in Kenya. This could be the case in other African countries. Since the introduction of plastination method in 1978, the available information in the literature is scanty. Incidentally, some international scientists from countries where the method is used were also not familiar with it.

In plastination as in conventional methods, fumes from fixatives and acetone pose a hazard. In addition, special equipment is needed for plastination. This may have been a dissuasion in ready acceptance of this method. Although the recommendation of plastination as a method amongst the participants was high (66%), the hesitancy of those who did