Post-Embalming Perfusion with **INFUTRACE™** *Limits the Exposure to Hazardous Vapours*

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A new post-embalming Infutrace™ perfusion technique was used in our anatomy laboratory to determine if ambient vapour levels of formaldehyde and phenol could be reduced.

A group of 12 cadavers were routinely embalmed via the femoral artery. Following a seven day fixation period the cadaver was perfused with a 20% Infutrace™ solution, a commercially available non-hazardous solution. Prior to dissection intraperitoneal formaldehyde and phenol vapour levels were measured using low level formaldehyde and phenol vapour detection tubes. Measured levels were compared to those obtained from non-Infutraced cadavers, determining the concentration of vapour levels within the cadaver. In addition, environmental formaldehyde levels were recorded before, during and after dissection periods and compared to similar measurements made prior to implementation of this post-embalming technique. The results demonstrated a dramatic reduction (95%) of intraperitoneal formaldehyde and phenol levels following Infutrace™ perfusion. Ambient formaldehyde and phenol vapour levels in the dissection laboratory were consistently below exposure limits set by the National Institute for Occupational Safety and Health (NIOSH). We have also observed a significant reduction of student and faculty concerns resulting from exposure to noxious fixatives since this Infutrace™ post-embalming procedure was implemented. It is suggested therefore that whole-body secondary perfusion of cadavers following standard formaldehyde embalming procedures may be a simple, inexpensive technique to reduce exposure to chemical irritants during anatomical dissections.

INFUTRACE™

- Infutrace™ is NOT a fixative, but is a solution used in the secondary treatment of fixed tissue or embalmed cadavers.
- Infutrace™, when properly used, will significantly reduce the toxic vapour levels of formaldehyde and phenol.

Note: Tissue must be well fixed with a formaldehyde based fixative or embalming fluid prior to any treatment with INFUTRACE™.

Dilution for use:

- Infutrace™ is diluted to a 20% solution with tap water prior to use.

Other fixatives:

Some chemicals found in other fixatives which do not interfere with the reaction of Infutrace™ include:

- chloral hydrate
- EDTA
- phosphate buffers
- acetate buffers
- glutaraldehyde.

EMBALMING FLUID RECIPES USED IN THIS PAPER

Control Cadavers (fig. 1)

700ml	Dettol (35%)
500ml	phenol (2.5%)
500ml	37% formaldehyde*
12L	methanol (60%)
3.4%	propylene glycol (17%)
166gm	sodium acetate
water	to total volume of 20 litres (5 gallons)

* 2.5% formaldehyde or 7% formalin

Test Cadavers (fig. 2)

1L	Dettol (4.2%)
1L	phenol (4.2%)
3L	37% formaldehyde*
13L	alcohol** (54%)
4L	propylene glycol (16.6%)
20 ml	thymol
water	to total volume of 24 litres (6 gallons)

* 12.5% formaldehyde or 33.8% formalin
** 85% ethanol, 15% methanol

INGREDIENTS AND HAZARDS OF EMBALMING FLUID

Dettol:

- Considered an irritant
- 4% 4-chloro-3, 5-xylenol (a.k.a. 4-chloro-3, 5-dimethylphenol)
- 9.4% Isopropyl alcohol
- 8.4% Pine Oil

Phenol:

- Considered highly toxic and corrosive
- used as a mould inhibitor

Formaldehyde:

- Considered highly toxic and a cancer suspect
- used as a true fixative (i.e. cross links the proteins)
- used to kill micro-organisms by cross linking

Alcohol:

- used to fix tissue by drying

Propylene glycol:

- considered an irritant
- used to counteract the drying effects of the above

Sodium acetate:

- used as a buffer

PART 1: EMBALMING METHOD

1. A hole is drilled into the saggital sinus of the skull to facilitate the fixation of the brain.
2. Embalming fluid is perfused via the femoral artery following the normal procedure at 10 PSI. Canuli are left until Infutrace™ treatments are completed.

   Perfusion is done over several days with lesser amounts of embalming fluid being perfused each time.

   Day 1: Most of the embalming fluid is perfused into the cadaver (i.e. about 4-5 gallons or an appropriate volume for size of cadaver.

   Day 2: Approximately 2 gallons of embalming fluid are perfused to compensate for leakage.

   Day 3: Approximately 1 gallon of embalming fluid is perfused to compensate for any additional leakage.

   (The volume of embalming fluid is determined by the size and the condition of the individual cadaver.)
3. The cadaver is then allowed to fix for at least 7 days.

After the fixation period has elapsed, it is time for the introduction of Infutrace™...

PART 2: INFUTRACE™ TREATMENT

4. One gallon of a 20% Infutrace™ solution is perfused into an average size cadaver.

   (The actual volume of 20% Infutrace™ used in a cadaver is 1/4 of the volume of embalming fluid estimated to be in the cadaver.)
5. The chemical reaction within the cadaver is completed overnight.

   (Cadavers can be stored after the introduction of Infutrace™ assuming that the cadaver is not to be latexed.)

PART 3: LATEX TREATMENT

6. If latex is to be used, it can be introduced using the normal method a couple days after the introduction of Infutrace™.
7. The canuli are then removed and the cadaver can be stored.

REACTION WITHIN THE CADAVER

The Infutrace™ will react with the free formaldehyde and phenol in the cadaver over the next 24 hours. A polymer is formed, thus converting the toxic chemicals into a non-hazardous end product. There is no alteration to the tissue nor is the fixation removed from the tissue.

TESTING PROCEDURE

Cadavers were embalmed and Infutraced in the method previously described, then...

1. A trocar was inserted into the abdominal cavity of each cadaver.
2. An appropriate Sensidyne Gastec* gas detection tube was place at the open end of the trocar.

   * Low level 0.5-32.5 ppm formaldehyde detection tube #91L and phenol detection tube #60 with a measuring range 0.4-187 ppm.
3. A gas sample was extracted through the tube with the Sensidyne Syringe. The direct readout (ppm) of each gas is noted in Figures 3,4 and 5.

Gas extracted form within the cadaver was not affected by anything other than Infutrace™.

TEST RESULTS – FORMALDEHYDE VAPOUR LEVELS

CONTROL CADAVERS (figure 3)

Cadaver Number	*Formaldehyde Vapour Level (ppm)*
508	32.5
551	40
562	15*
565	23*
Mean formaldehyde level within the cadavers is 27.6 ppm.	

* 1 year post embalming.

TEST CADAVERS (figure 4)

Cadaver Number	*Pre-Infutrace™ (ppm)*	*Post-Infutrace™ (ppm)*	*Drop in vapour level %*
12-97	40	0.2	99.5
13-97	19	0.5	97.4
14-97	40	2.0	95.0
15-97	9.0	0.5	94.4
16.97	23	0.2	99.1
01-98	40	2.5	93.8
02-98*	23	6.0	73.9
15-98	7.0	0.5	92.9
17-98**	26	0.5	98.1
18-98**	17	0.2	98.8
Mean	**24.4**	**1.3**	**94.6**

* whole body perfusion was difficult due to severe atherosclerosis.

** 1.5 gallons of 20% Infutrace™ were perfused into these cadavers.

TEST RESULTS – PHENOL VAPOUR LEVELS

TEST CADAVERS (figure 5)

Cadaver Number	*Pre-Infutrace™ (ppm)*	*Post-Infutrace™ (ppm)*	*Drop in vapour level %*
12-97	25	3	88.0
14.97	20	0	100
01-98	13	2	84.6
02-98*	25	1	96.0
17-98**	19	0	100
18-98**	3	0	100
Mean	**17.5**	**1.0**	**94.3**

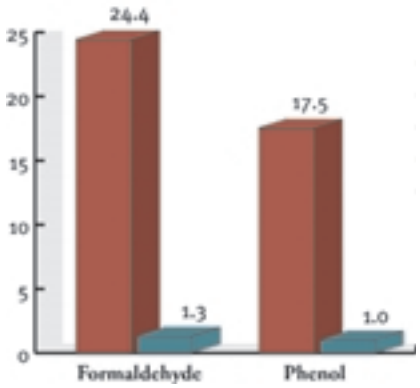
* whole body perfusion was difficult due to severe atherosclerosis.

** 1.5 gallons of 20% Infutrace™ were perfused into these cadavers.

- Random air sampling within the dissection laboratory showed no detectable levels of formaldehyde or phenol regardless of the number of cadavers. This has also been confirmed by several other anatomy laboratories using this product.
- The acceptable TLV (Threshold Limit Value) for formaldehyde is 1 ppm and phenol is 5 ppm.

RESULTS

FORMALDEHYDE AND PHENOL VAPOUR LEVEL REDUCTIONS



- Formaldehyde and phenol vapour levels were significantly reduced to below acceptable TLV levels using Infutrace™.
- One gallon of Infutrace™ will drop formaldehyde and phenol levels by about 95%.
- There is no need to increase the volume of Infutrace™ because the same results occur with 1 gallon as with 1.5 gallons.

LEAKAGE

Once Infutrace™ has been introduced into the cadaver, vapour levels from leaking fluids will be reduced.

CAVITY FLUID BUILD-UP

To reduce vapour levels, inject approximately 100 ml. of 20% Infutrace™ into each of the right and left thoracic cavities and into the abdominal cavity a class or day prior to dissection.

MOULD GROWTH

A mould inhibitor is incorporated into Infutrace™.

WETTING AGENT

A 20% Infutrace™ spray solution can be used as a moistening agent during dissection and between classes.

OTHER USES FOR INFUTRACE™

Autopsy rounds and prosections

A 20% Infutrace™ solution can be used as a dip and/or spray on tissues an hour or so prior to display.

Conference specimens

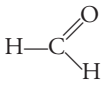
A 20% Infutrace™ solution can be used as a dip and/or spray for well fixed tissue that are to be transported and displayed for demonstration purposes.

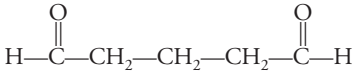
Brains stored in 20% Formaldehyde

Method for removing formaldehyde from tissue:

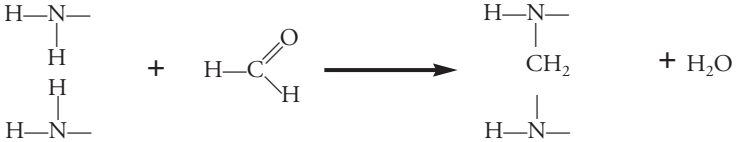
5% Infutrace™	1 hour
5% fresh Infutrace™	1 more hour
20% Infutrace™ solution	for use

FORMALDEHYDE FIXATION

Formaldehyde: 

Glutaraldehyde: 

A cross link of proteins occurs between the aldehyde and nitrogen.



2 amino groups + formaldehyde ⟶ cross link between 2 protein chains at the nitrogen site (no aldehyde group) + water

Formaldehyde therefore FIXES the tissue (i.e. stops the degeneration of protein chains) by blocking the available site for bacterial decomposition.

Infutrace™ works by using the aldehyde group in the formation of a polymer. Since there are no aldehyde groups left after the fixation process, Infutrace™ does not interfere with the fixation. The only aldehyde used in the reaction is the free, unattached aldehyde, which did not attach to the tissue during the fixation process.

HAZARDOUS VAPOURS IN THE WORKPLACE

JAMA, March 24/31, 1999 – Vol. 281, No. 12: 1106-1109

Occupational exposure to organic solvents during pregnancy has been shown to increase the risk of major fetal malformations. The increased risk of major malformations is reported to be 13 fold.

The organic solvents which women may be exposed to in the workplace include: xylene, phenol, acetone, aliphatic and aromatic hydrocarbons, vinyl chloride, trichloroethylene and related compounds.

The results suggest that fat-soluble solvents can pass through biological membranes, specifically the placenta.

REDUCE THE RISK WITH SASCO PRODUCTS

Anatomy labs

Infutrace™ reduces Formaldehyde and Phenol vapours by 95% during storage shipping and dissection.

Pathology labs and morgues

Formaldehyde vapour levels can be reduced during formalin disposal using Formalex® and Purgemaster™

Products are manufactured by:

S&S Company of Georgia, Inc.
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