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Original Research Article

Title: Modern method of commercial embalming of poisoned decomposing carcasses in Nigeria.

ABSTRACT

Certain poisons speed-up the rate of decomposition of carcasses, and this has become a cause of concern to embalmers because of the difficulty such bodies present. Therefore, a suitable modern embalming method has been reported in this study in order to abate, slow and completely halt decomposing bodies resulting from poisoning. This study was carried out to validate the effectiveness of an embalming mixture containing formalin, methanol and water on early decomposing poisoned bodies. Four domestic pigs (*Sus scrofa domestica*) were used for this experiment. Animals were sacrificed and allowed to reach the early stage of decomposition before embalmment. Arterial embalming technique was employed which was supplemented by hypodermic embalming technique. A Pearson correlation analysis was used to determine the relationship between the outcome of embalming and the independent variables such as volume of embalming fluid, humidity, room temperature, atmospheric temperature, and duration of embalming. The visible post embalming changes showed that decomposition was arrested on the eighth day which was followed by mummification of the animals. The Pearson correlation analysis showed that there was a statistically significant strong positive correlation between outcome of embalming and duration of embalming; a statistically significant moderate negative correlation with volume of embalming fluid; and a statistically significant moderate negative correlation with room temperature. An embalming mixture containing formalin, methanol and water in equal proportion is suitable for arresting early decomposition of poisoned bodies using arterial and hypodermic embalming techniques.

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KEYWORDS

Decomposition, Embalming, Gravity-feed, Poisoning.

BACKGROUND

Decomposition process involves the breakdown of body component by its enzymes (autolysis) and microorganisms (putrefaction).[1] Decomposition of dead bodies resulting from Sniper or other poisonous substances have been reported to present difficulties to embalmers in Anambra state, Nigeria.[2,3] This is because poisonous substances such as Snipers have an adverse effect on body enzymes and proteins which in turn, negatively reacts with embalming chemicals such as formaldehyde and methanol.[2]

Poisoning is the commonest form of suicide, and one of the commonest homicides in Nigeria. The popular choice of poison for suicides in Nigeria is Sniper.[4] Sniper is a DDVP, 2,2-dichlorovinyl dimethyl phosphate compound produced by a Swiss-Nigerian chemical compound, as a synthetic organophosphorus;[5] but popularly used in Nigeria as an insecticide because of its effectiveness compared to other brands.[6] However, there have been several reports on homicides and suicides resulting from Sniper in Nigeria especially in Anambra state.[7-10] This led to the ban on the manufacture of small bottle Sniper by the federal government of Nigeria in 2019.[6] In 2018, the Anambra state government also banned the use of Sniper for the preservation of green seeds by marketers.[11]

Over the years, researchers have continued to develop new methods of slowing or halting decomposition of human remains. The main reasons for preventing or arresting decomposition process are mainly for disinfection,[12,13] sanitization,[13.14] and preservation[13-15] in order to prepare the body for burial;[13] to prepare the whole or some

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of the body parts for museum purpose[13,16] and for cadaveric studies.[13,17-19] This means that the choice of an embalming fluid must take into account its disinfectant and germicidal properties;[13] and must be able to arrest decomposition, thereby stopping the spread of diseases from the bodies.[20] In addition, the choice of embalming technique contributes to the outcome of an embalming.[3] So many authors have presented different techniques for preventing and slowing down decomposition process. These techniques include evisceration, mummification, cryopreservation, plastination and other arterial modern embalming methods.[12-14]

Modern embalming methods require formaldehyde-based compositions such as formalin-water fluid, Thiel embalming fluid, Kaiserling embalming fluid, Genelyn embalming solution, Neumann embalming fluid, Tutsch embalming fluid, Onyejike embalming fluid, Jores embalming fluid and Anderson embalming fluid;[3,13] non-formaldehyde based compositions such as ESCO embalming solution, Førlich embalming fluid, St. George's embalming fluid, Universidade Nova de Lisboa embalming solution, bronopol-based solution, Hammer embalming fluid, polyhexamethyleneguanidine hydrochloride (PHMGH) solution, glutaraldehyde-based solutions, ∂-lactones, ionic liquids and honey;[3,16] and deformalinizing solutions.[21]

Formalin-based compositions have been an acceptable modern method of embalming irrespective of its adverse properties.[22] Formalin-embalming is also the cheapest and most popular method of commercial embalming.[22,23] In addition, a study carried out at the commercial embalming centres in Nigeria noted that the most popular embalming fluid which yielded the best outcome for arresting decomposing bodies (resulting from poisoning) contained a mixture of 30 litres of 20% concentrated formalin, 10 litres of 50% concentrated

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methanol, 150 grams of ammonium salt, 5 litres of glycerine, 60 litres of water, 10 grams of thymol and 150 grams of arterial dye.[3] The active preservatives in this mixture are formaldehyde and methanol. However, this study could not identify the actual stage of decomposition this embalming mixture can arrest. Therefore, this study aimed at carrying out an experiment to validate the effectiveness of an embalming fluid containing formaldehyde, methanol and water on early decomposing bodies using porcine analogues.

METHODS

Ethical approval and consideration

The ethical approval was obtained from the ethical committee, Faculty of Basic Medical Science, College of Health, Nnamdi Azikiwe University, Nnewi Campus. The certification number is NAU/CHS/NC/FMBS/OD/303 dated 16th July, 2021. Few number of animals were approved for the study due to the mode of death (sacrifice).

Materials

The materials used for the study include 40% formalin, 10% methanol, water, 10 mL of sniper, and four domestic pigs.

Location of the study

This study was carried out at the Gross Anatomy laboratory of the Department of Anatomy, Nnamdi Azikiwe University, Nnewi campus, Nigeria.

Experimental animals

The experimental animals used for the study were four (two males and two females) infant domestic pigs (*Sus scrofa domestica*) because of the ethical issues related to the mode of death of the animals. The animals were procured from a pig farm located very close to the study location. Animals were in healthy condition before they were sacrificed.

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Experimental procedure

This study design was a single-case experimental study design. The concept used for the research procedure was formulated by the researchers. Data on the observable decomposition changes of the animals were collected by the researchers. The peri-mortem and post-mortem body temperatures of the pigs were documented.

Animals were sacrificed and death confirmed when no heart beat was recorded using stethoscope and observation of the pupillary reflex. The exact time of death was recorded. Early visible signs of decomposition (algor mortis, rigor mortis, pallor mortis, livor mortis) were monitored for eight hours. The choice of this timeline is because it is the usual timeline for reporting suicide cases at funeral homes in Anambra state, Nigeria. In addition, this is the timeline for early decomposition in Anambra state, Nigeria.[24] After eight hours, the animals were embalmed via cervical arterial embalming technique which was supplemented by hypodermic embalming technique. Embalming activities were completed when all the body parts appeared hard and filled with embalming fluid. Animals were re-embalmed on the fourth day, fifth day and seventh day.

The atmospheric temperature, room temperature, and humidity were recorded from the time of death till the last day of the study. The post embalmment changes were monitored morning, afternoon and evening for two weeks and subsequently monitored morning and evening until the end of the study. The body structures that were completely fixed and mummified were scored whereas the body parts not fixed were not scored.

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Method of data collection for daily climate readings

The thermo-hygrometer was placed on the slabs of the dissecting room and the wire extended outside the room via its window. The time was set on the equipment to GMT (+1) to ensure accuracy in documenting the readings. The lowest atmospheric temperature of the day was recorded between 3am and 7am; and the highest atmospheric temperature of the day recorded between 11am and 3pm. The lowest humidity of the day was recorded between 11am and 3pm; and the highest humidity of the day recorded between 3am and 7am.

Method of embalming

The 40% formaldehyde, 10% methanol and water were measured using a measuring cylinder each at 1000ml. Water was first measured, and this was followed by the measurement of formalin and methanol. Methanol was measured last because of its high evaporation property. Single point method of arterial embalming technique via the internal carotid artery was used, which was supplemented by hypodermic embalming technique in order to ensure that the embalming fluid circulated to all the body parts.

Scoring Method

The researchers developed a scoring method for the completely fixed parts of the carrions post-embalmment. The completely fixed parts were scored '1', whereas the unfixed parts were either scored '0' or not scored at all. The head and neck body structures that were scored are crown, two ears, two eyes, oral region, snout, dorsal aspect of the neck and ventral aspect of the neck. The body structures of the trunk that were scored are tail, umbilical

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region, thorax, dorsal aspect of the trunk and the anorectal region. The four limbs were scored individually.

Experimental control / precaution

Animals were procured from a farm close to the research facility in order to ensure that there was no change in body thermal condition. Animals were procured very early in the morning between 5am and 6am, and allowed to rest and acclimatize for a period of 1 hour before sacrifice.

We avoided parallax error when reading the animal weight on the analogue weighing scale. The thermometer was cleaned with cotton wool and methylated spirit, and dried after every rectal reading to ensure accuracy in data collection.

Statistical analysis

The statistical tool used for this study was SPSS IBM series version 25. The data were descriptively and inferentially analyzed and represented in tables.

Pearson correlation was used to test the relationship between outcome of embalming (represented as post-embalming body scores – PBS) and the independent variables that could affect the outcome of embalmment. These independent variables include humidity, volume of embalming, duration of embalming, atmospheric temperature and room temperature.

Duration of research

This study lasted for a period of 42 days (from April 2021 to May 2021).

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RESULTS

Body statistics of experimental animals

The peri-mortem body statistics of the animals showed that the animals were infants (about two months old). The body temperatures of the animals were at optimal levels (Table 1).

The body temperatures of all the animals significantly decreased after eight hours (Table 2). The body weight of some of the animals slightly decreased after eight hours (Table 2); and there was a significant decrease in body weight of all the animals at the end of the study (42nd day post-mortem).

Visible post-embalming changes

The first sign of decomposition was algor mortis which started 30 minutes after death (Table 3). This was followed by rigor mortis which started about one hour after death; then pallor and livor mortises immediately followed one hour later (Table 4). Other visible post mortem changes that occurred within the first eight hours after death are fluid discharge from the mouth, anus, and nostril; discharge of faecal matter from the anus; increase in intra-abdominal pressure and bloating of trunk (Table 4). There was no putrid odour or fly activity.

By the third day, decomposition was already slowing down on all the animals; and some of the body structures of three of the animals were completely fixed and mummifying (Figure 2; Table 5). The entire body structures of one of the animals became completely fixed and mummified by the eighth day (Figure 3; Table 6). The other animals became completely

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fixed and mummified with no putrid odour or colour discoloration by the 11th day; and this mummification process continued to intensify till the last day of the study which led to shrinkage of the trunk and other structures of the animals' body (Figure 4; Table 7).

Relationship between the outcome of embalmment and independent variables

The dependent variable for this study is the outcome of embalmment. The independent variables for this study are the factors that influence the rate of decomposition which in turn could affect the outcome of embalmment. The independent variables include room temperature, humidity, atmospheric temperature, volume of embalming fluid and duration of post-embalming (Table 8).

Pearson correlation analysis showed that there was a statistically significant strong positive correlation ($r = .659$, $n = 42$, $p = .001$) between outcome of embalming and duration of embalming; a statistically significant moderate negative correlation ($r = -.574$, $n = 42$, $p = .001$) between outcome of embalming and volume of embalming fluid; and a statistically significant moderate negative correlation ($r = -.426$, $n = 42$, $p = .001$) between outcome of embalming and room temperature. However, Pearson correlation analysis showed that there was a statistically insignificant weak positive correlation ($r = .282$, $n = 42$, $p = .070$) between outcome of embalming and humidity; and a statistically insignificant very weak negative correlation ($r = -.157$, $n = 42$, $p = .320$) between outcome of embalming and atmospheric temperature.

DISCUSSION

The significant decrease in body temperature of the animals after eight hours indicates algor mortis which is one of the early signs of decomposition. Other post mortem activities that were visible within this period are pallor, rigor and livor mortises. These are notable events of

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fresh and early bloat stages of decomposition. [25-27] Therefore, the visible post mortem changes indicate that decomposition progressed from fresh stage to early bloat stage before the animals were embalmed. The animals did not actively decay due to the effectiveness of the embalming method.

The significant decrease in body weight at the end of the study means that the animals were completely fixed leading to mummification. In addition, formaldehyde has been reported to dry cadavers preventing microbial and arthropod activities.[28] More so, the decomposition process of all the animals was completely arrested on the 11th day which indicates that the embalming fluid was very potent in arresting decomposition. It has also been reported that when methanol is added to a formalin solution, it prevents the polymerization of formaldehyde and also establishes the proper density of the solution.[29]

The outcome of embalming was positively affected by the duration of embalming which means that as duration progressed, the animals became more fixed. The outcome of embalming was negatively influenced by volume of embalming fluid and room temperature, which means that the embalming mixture is very reliable because little amount is needed to arrest decomposition; and low room temperatures (between 23^0C and 28^0C) aid the preservation of bodies in the morgue. The constituents of the embalming fluid used in this study have been reported by several authors to possess strong preservative effects on decomposing bodies.[3,13,28,30] The outcome of embalming was not influenced by atmospheric temperature and humidity; and therefore, the two variables should not be considered when embalming decomposing poisoned bodies in Nigeria.

CONCLUSIONS

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The embalming fluid used for this study is reliable, accessible and affordable for commercial embalming of decomposing bodies. Since porcine models are acceptable analogues for taphonomic research, a 12-litres embalming fluid suitable for arresting early decomposition of poisoned human bodies should constitute four litres of 40% formaldehyde, four litres of 10% methanol and 4 litres of water.

The gravity-feed tank is an effective medium (equipment) for circulation of embalming fluid in the body; and it is also affordable and easier to maintain. The embalming process should be by single point arterial embalming which should be supplemented by hypodermic embalming. In addition, there should be frequent monitoring of the embalmed bodies within the first eight days to ensure that any part of the body decomposing is arrested using hypodermic embalming. This is referred to as post-embalming management; and it is required to achieve a quick and successful result.

RECOMMENDATIONS

Based on the findings from this study, the following are recommended:

1. Eosin dye should be added to the embalming fluid identified in this study when embalming human cadavers in order to maintain the dermal colour.
2. Further studies should be carried out with mature porcine models to validate the efficacy of this mixture.
3. Further studies should be carried out to validate the efficacy of this mixture on late bloat and active decay stages of decomposition.
4. More animals (an approximate of 30 animals) should be approved by the Animal protection index of Nigeria in order to ensure accuracy of the reports.

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DECLARATION OF INTEREST STATEMENT

This research article is an original article. It has not been submitted for review to another journal and has not been published in any journal or conference proceedings.

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FIGURE LEGENDS

Figure 1: Day 1 – After embalming

Figure 2: Day 3 Post-embalming changes

Figure 3: Day 8 Post-embalming

Figure 4: Day 42 Post-embalming

DATA AVAILABILITY STATEMENT

The datasets generated during and / or analyzed during the current study are available within the text.

WORD COUNT: 2383

FIGURES

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Figure 1: Day 1 – After embalming

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Figure 2: Day 3 Post-embalming changes

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Figure 3: Day 8 Post-embalming

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Figure 4: Day 42 Post-embalming

TABLES

Table 1: Perimortem body statistics

BODY STATISTICS	PIG 1	PIG 2	PIG 3	PIG 4
Weight (Kg)	12	12.5	13	12.5
Body Temperature (^{0}C)	40.2	39.2	40.1	39.3
Recumbent Length (cm)	63	62	63	63
Chest Circumference (cm)	38	41	42	39
Waist Circumference (cm)	39	38	39	40
Atmospheric temperature at death (^{0}C)	31.0	31.0	31.7	32.1
Time of death	8.33am	8:33am	8:35am	8:36am

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Table 2: Post-mortem body statistics

BODY STATISTICS	PIG 1	PIG 2	PIG 3	PIG 4
Weight after 8 hours (Kg)	12.5	12.5	13.5	13.0
Body temperature after 8 hours (^{0}C)	31.0	31.0	30.5	31.5
Weight at day 42 (Kg)	6.0	6.0	7.0	6.0

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Table 3: DAY 1 Data – 10 Minutes Periodic observations after Death

TIME	BT (^{0}C)	AT (^{0}C)	RT (^{0}C)	VISIBLE CHANGES	Insect Activities
8:33	39.7	27.5	28.0	No pupillary reflex, discharge of fluid from the anus at 8:36am	Nil
8:43	39.7	27.8	28.1	Discharge of foamy fluid from the mouth.	Nil
8:53	39.7	27.5	28.2	Oral and anal discharge continues.	Nil
9:03	37.1	27.7	28.3	Discharge of faecal matter from the anus. Algor mortis starts.	Nil
9:13	37.1	28.4	28.4	Intra-abdominal pressure increases.	Nil
9:23	37.1	28.4	28.6	Intra-abdominal pressure continues to increase.	Nil
9:33	36.7	29.1	28.7	Intra-abdominal pressure continues to	Nil

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increase.

BT. Body temperature

AT. Atmospheric temperature

RT. Room temperature

Table 4: DAY 1 Data – Hourly Observation

TIME	BT (^{0}C)	AT (^{0}C)	RT (^{0}C)	VISIBLE CHANGES	Insect Activities
10:33	34.3	30.9	29.6	Rigor Mortis starts by 11:05am	Nil
11:33	32.0	32.6	30.2	Livor and pallor mortises start at 11:38am	Nil
12:33	31.0	33.5	31.3	Algor, rigor, pallor and livor mortises progress with increase of intra-abdominal pressure.	Nil
1:33	31.0	34.5	32.1	Discharge of foamy fluid from the nostril at 2:17pm.	Nil
2:33	31.0	34.4	36.4	Continuous discharge of foamy fluid from the nostril.	Nil
3:33	31.0	38.4	33.9	Algor, rigor, pallor and livor mortises progress with increase of intra-abdominal pressure.	Nil
4:33	31.0	34.4	33.1	Algor, rigor, pallor and livor mortises progress with early bloating.	Nil

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BT. Body temperature

AT. Atmospheric temperature

RT. Room temperature

Table 5: DAY 3 Post-embalming visible changes

Time	Head & neck visible changes	Trunk visible changes	Limbs visible changes
Morning (6.15am)	The snout, crown appeared fresh and decomposing with no discolouration. The neck, lips and eyelids were actively decomposing with putrid odour.	The entire trunk and tail appeared fresh and decomposing. There was no putrid odour or skin discolouration. There were no insect activities.	The fore and hind limbs appeared fresh and decomposing.
Afternoon (12.30pm)	No visible change different from what was observed in the morning.	No visible change different from what was observed in the morning.	No visible change different from what was observed in the morning.
Evening (6.30pm)	No visible change different from what was observed in the afternoon.	No visible change different from what was observed in the afternoon.	No visible change different from what was observed in the afternoon.

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Table 6: DAY 8 Post-embalming visible changes

Time	Head & neck visible changes	Trunk visible changes	Limbs visible changes
Morning (6.17am)	Decomposition gradually slowed down on the neck region and one of the ears with skin discolouration. Other structures of the head were completely fixed with no putrid odour. The eyelids were mummifying.	The tail was fixed and discoloured. The ventral aspect of the trunk was mummifying. The dorsal aspect of the trunk and anorectal region were completely mummified. There were no fly activities and no skin discoloration of the trunk.	All the limbs were completely fixed except one of the forelimbs.
Afternoon (12.00pm)	No visible change different from what was observed in the morning.	There was a decrease in bloated trunk.	No visible change different from what was observed in the morning.
Evening	No visible change different	The bloated trunk	The hind limbs were

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(6.00pm)	from what was observed in the afternoon.	continued to slowly decrease.	mummifying.

Table 7: DAY 42 Post-embalming visible changes

Time	Head & neck visible changes	Trunk visible changes	Limbs visible changes
Morning (6.12am)	All the structures of the head and neck region were mummified.	All structures of the trunk were mummified.	All the limbs were mummified.
Evening (6.20pm)	No visible changes.	No visible changes.	No visible changes.

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Table 8: Pearson Correlation between the outcome of embalming and all the independent variables used for the study

		Days of Embalming	Average Atmospheric Temp.	Average Humidity	Average Room temp.	Average Total Post-Embalming Body Score	Average VEF
Average Total Body Score (Outcome of embalming)	Pearson Correlation	.659**	-.157	.282	-.426**	1	-.574**
	Sig. (2-tailed)	.000	.320	.070	.005		.000
	N	42	42	42	42	42	42

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

KEY TO QUALITY OF RELATIONSHIP

0.80 – 1.00 Very strong positive

0.60 – 0.79 Strong Positive

0.40 – 0.59 Moderate positive

0.20 – 0.39 Weak positive

0.00 – 0.19 Very weak positive

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Table 9: Post-embalming body scores (outcome of embalming) of the pigs and Volume of embalming fluid applied

DAY	TPBS 1	TPBS 2	TPBS 3	TPBS 4	CTPBS	ATPBS	VEF 1 (ml)	VEF 2 (ml)	VEF 3 (ml)	VEF 4 (ml)
1	0	0	0	0	0	0	1400	1500	1400	1500
2	0	0	1	1	2	1	0	0	0	0
3	3	0	1	2	6	1.5	0	0	0	0
4	5	0	2	3	10	2.5	340	340	340	340
5	8	0	4	4	16	4	200	200	200	200
6	10	3	6	7	26	6.5	0	0	0	0
7	15	11	10	16	52	13	280	280	280	280
8	15	16	13	18	62	15.5	0	0	0	0
9	15	18	15	18	66	16.5	0	0	0	0
10	16	18	16	18	68	17	0	0	0	0
11	18	18	18	18	72	18	0	0	0	0
12	18	18	18	18	72	18	0	0	0	0
13	18	18	18	18	72	18	0	0	0	0
14	18	18	18	18	72	18	0	0	0	0
15	18	18	18	18	72	18	0	0	0	0
16	18	18	18	18	72	18	0	0	0	0
17	18	18	18	18	72	18	0	0	0	0
18	18	18	18	18	72	18	0	0	0	0
19	18	18	18	18	72	18	0	0	0	0
20	18	18	18	18	72	18	0	0	0	0
21	18	18	18	18	72	18	0	0	0	0
22	18	18	18	18	72	18	0	0	0	0
23	18	18	18	18	72	18	0	0	0	0
24	18	18	18	18	72	18	0	0	0	0
25	18	18	18	18	72	18	0	0	0	0
26	18	18	18	18	72	18	0	0	0	0
27	18	18	18	18	72	18	0	0	0	0
28	18	18	18	18	72	18	0	0	0	0
29	18	18	18	18	72	18	0	0	0	0

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30	18	18	18	18	72	18	0	0	0	0
31	18	18	18	18	72	18	0	0	0	0
32	18	18	18	18	72	18	0	0	0	0
33	18	18	18	18	72	18	0	0	0	0
34	18	18	18	18	72	18	0	0	0	0
35	18	18	18	18	72	18	0	0	0	0
36	18	18	18	18	72	18	0	0	0	0
37	18	18	18	18	72	18	0	0	0	0
38	18	18	18	18	72	18	0	0	0	0
39	18	18	18	18	72	18	0	0	0	0
40	18	18	18	18	72	18	0	0	0	0
41	18	18	18	18	72	18	0	0	0	0
42	18	18	18	18	72	18	0	0	0	0

TPBS 1. Total post-embalming body score for Pig 1

TPBS 2. Total post-embalming body score for Pig 2

TPBS 3. Total post-embalming body score for Pig 3

TPBS 4. Total post-embalming body score for Pig 4

CTPBS. Cumulative total post-embalming body scores

ATPBS. Average total post-embalming body scores

VEF 1. Volume of embalming fluid used to fix Pig 1

VEF 2. Volume of embalming fluid used to fix Pig 2

VEF 3. Volume of embalming fluid used to fix Pig 3

VEF 4. Volume of embalming fluid used to fix Pig 4

Table 10: Climatic factors that influence decomposition

DAY	HAT (^{0}C)	LAT (^{0}C)	HH (%)	LH (%)	HRT (^{0}C)	LRT (^{0}C)
1	38.4	27.8	92	63	33.9	28.1
2	30.1	22.4	98	77	33.4	24.1
3	30.1	22.5	92	72	30.0	24.5

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4	32.6	24.0	94	65	30.6	25.8
5	32.4	24.8	96	65	31.9	26.0
6	33.4	25.4	92	52	32.2	26.9
7	33.4	26.5	88	65	31.0	28.3
8	34.2	23.6	93	74	31.1	24.1
9	29.4	24.1	95	74	29.0	23.6
10	30.3	23.0	94	62	29.7	23.4
11	33.4	24.4	96	70	31.1	23.7
12	34.6	23.2	94	69	31.2	24.1
13	40.0	23.6	90	65	32.4	23.4
14	39.4	24.5	93	53	33.5	23.9
15	33.5	22.3	97	71	31.2	23.5
16	33.3	23.6	97	69	31.2	23.2
17	34.0	23.1	92	66	32.3	23.8
18	33.9	22.9	98	76	30.9	23.1
19	34.8	24.1	94	68	31.5	23.7
20	34.0	22.7	95	66	30.0	23.9
21	31.2	21.5	99	77	23.5	23.1
22	31.6	22.7	93	74	29.8	24.8
23	30.6	22.2	96	77	28.9	24.1
24	32.0	22.1	97	76	29.9	23.4
25	31.6	23.4	95	72	30.8	23.9
26	35.4	23.7	98	69	32.3	24.1
27	26.8	21.2	99	87	25.7	23.1
28	32.1	22.1	99	72	29.8	24.6
29	32.5	24.4	97	70	30.4	29.0
30	32.2	24.7	94	72	30.2	26.2
31	32.7	24.8	91	69	30.1	26.1
32	32.5	25.4	92	77	29.7	26.7
33	27.5	24.4	99	91	28.5	25.8
34	31.2	25.1	99	90	30.1	26.2
35	27.6	22.1	92	88	27.1	24.4
36	31.5	23.5	95	77	29.0	24.6

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37	26.8	21.8	89	80	26.2	23.4
38	30.9	23.4	97	75	29.4	24.4
39	33.2	24.4	84	68	30.5	26.1
40	31.8	26.3	98	75	30.7	27.4
41	31.9	24.5	92	80	29.9	27.1
42	30.8	24.5	95	79	29.9	26.2

HAT. Highest atmospheric temperature

LAT. Lowest atmospheric temperature

HH. Highest humidity

LH. Lowest humidity

HRT. Highest room temperature

LRT. Lowest room temperature