

# Scientific Technique for Skeletons Preservation and Preparation of Anatomical Models to Promote Veterinary Anatomy

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With 4 figures, 2 tables

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## Abstract

This project presents the way of preparation and preservation of the skeleton models, to promote the veterinary students comprehension for the anatomy courses by knowing the general shape through its skeletons of domestic animal. The animals which were prepared for study were skinned and dissected, Then the internal organs were removed and preserved in 10 % formalin solution. The technique of skeleton preservation had five stages: bones boiling with sodium hydroxide, degreasing by 95% gasoline for 6-8 days, drying in natural temperature, bleaching through hydrogen peroxide for 24 hours and skeleton installation. Skeleton installation included arranging the bones consistently, and fixing them by plastic strips and pasting of the articular surfaces. The fore and hind limbs were supported by iron rods from inside. Finally, the skeleton was fixed on a wooden base. The skeletons mod-

els could be used to demonstrate osteology, applied anatomy and to promote scientific knowledge.

**Keywords:** skeletons, models, hydrogen peroxide

## Introduction

Skeleton models are very important and basic in anatomy halls and museums to promote anatomy comprehension which is considered the most important course in the pre-clinical stage. All the students were trained and given experience through the teaching of anatomy course by employing the cognitive learning process (Bloom 1956; Hafsa and Stanek, 2007). Skeleton give students a "hands-on" method for learning bone names and locations, as well as a visual tool to relate bone and joint structure to muscle structure (Greene et al., 1993).

The preservation of bones is usually processed through several chemical

and mobility steps included boiling and soaking and completion steps (Alloush and Al-sheikh, 2008; Hussain et al., 2007). The last authors soaked the specimens in water or an ammonia solution and the amount of fat varies depending on the type of animal. The easiest way to remove bone grease was to soak the bones in ammonia (Gram, 2006). Literature on animal conservation techniques is insufficient and very limited (Hussain et al., 2007).

## Materials and Methods

Adult diseased or post-mortem camel, horse, sheep, dog and birds as well as one ostrich were used for this study. The animals were euthanatized in the veterinary hospital, Department veterinary Medicine, Faculty of Agriculture and Veterinary Medicine, Qassim University, KSA.

The chemicals used were sodium hydroxide (NaOH, 99%) Gasoline (95%), mixture of hydrogen peroxide ( $H_2O_2$ , 37%), Ammonia ( $NH_3$ , 30%). The equipments used included fire place, steel barrels, pot boiling, rods, metal wires, adhesives screws, nuts and wooden base with moving wheels scalpels and blades, blunt dissection, plastic strips, and drill machine.

The animals were skinned and dissected by removing the muscles,

the ligaments and tendons of the whole body except some small fragments muscles and tendons on the bones. After necropsy, the organs as liver, stomach, kidneys, heart, lungs and male and female organs were removed and preserved in 10 % formalin solution for another future teaching.

The bones were boiled with NaOH for 4-8 hours according to the animal size large or small. The small tissue fragments which were on the bone were removed by putting them, in 95% gasoline for 6-8 days to get a clean bones completely, Then the bones were dried in a natural temperature for 24 hours. After that, they were whitened by dipping in 99% hydrogen peroxide solution for 48 hours in large animals and 24 hours for small ones. Finally, the bones were dried, collected and arranged to be a complete skeleton.

## Results

The vertebral column has been shaped by arranging the cervical, thoracic, lumbar, sacral and caudal vertebrae by fixing them with the iron rod from inside. The rod diameter was suitable for the skeleton model. Moreover, the articular surfaces were pasted with each other by adhesive material from the first cervical vertebra to the first sacral ones to give the vertebral column

more support and rigidity. On the other hand, the ribs were fixed with the thoracic vertebra by drilling holes in the ribs head which were between the consecutive thoracic vertebrae, then they attached together by copper wire and adhesive. The sternal ribs endings were attached by tapes of plastic hook.

The mandible was attached to skull via the condyloid process to the temporal bone by adhesive paste. Moreover, the mandibular teeth were adhered with the upper jaw to increase the connectivity, durability and strength.

The skull was installed to the vertebral column by increasing the length of the iron rod inside the column vertebra to suit the size of the skull (Table 1) and by entering it within the magnum foramen. Moreover, plastic hook were used to connect between magnum foramen of bone and the first cervical vertebrae.

The fore and hind limbs were assembled by placing the bones in the correct conformation as the reality. The holes of the proximal and distal ends of the long bones were placed sequentially in diameter until reaching the required rod diameter.

The scapula was attached by the tapes of plastic hook bands with ribs. Moreover, the femur was at-

tached with the pelvic bone at the acetabulum by drilling the femoral head and tied by tapes of plastic hook and using adhesive material, this gave it support and strength. The carpal, tarsus, patella and sesamoid bones were assembled and fixed with each other by adhesive super glue. The length of the iron rods inside the limbs was increased about 8-10 cm to fall within the wooden base to fix the skeleton, which was designed in proportion to the width and length of the animal.

The skeleton was given a support by using two stainless steel rods to carry the animal's body, the first at the level of the 2-3 thoracic vertebrae and the second at the level of sacral vertebrae which gave the desired strength and support.

## Discussion

The present study revealed that the preservation technique of skeleton model of large and small animals as well as of poultry might improve teaching of anatomy courses and provide the national museums with rare animal's skeletons models.

This study revealed that there were five steps of preservation technique of skeletons models, including boiling, degreasing, drying, bleaching and installation. Alloush and sheikh, (2008) mentioned that the bones

were prepared by the first four stages only. Previously, boiling bones was the only known process. Moreover, the topographic positions of bones and the angles formed between neighboring bones were unknown for student. Moreover, the boiling caused rot and texture fatty spam with foul smell later..All of these were uncomfortable for the teachers, students and technicians.

These results revealed that the large animals (camel, horse and ostrich) must be boiled for 8 hours (Greene et al., 1993 and Hussain et al., 2007) in horse. But, in this work, 4 hours were enough for the small animals and 2 hours for the poultry.

The long bones in large animals needed more time for boiling. This might be due to structure and size bones. On the contrary, the results showed that extra boiling of the flat and thin bones (skull and ribs) led to disintegration and fragility of the bones (Hussain et al., 2007).

In this project, gasoline 95% was used for degreasing, because it was very cheap and available. Nevertheless, to avoid irritation from vapors container must be remained strongly closed (Greene et al., 1993 and Gram, 2006). The gasoline has three disadvantages, fast inflammable, ignition and foul smell (Greene

et al., 1993). On the other hand, trichloroethylene is an excellent degreasing, but it is very expensive and danger (Tompsett, 1970 and Gram, 2006).

In this work, Bleaching processes using hydrogen peroxide 37% solution was suitable for getting better colour in shorter time. Greene et al., (1993), Gram (2006), Hussain, et al., (2007) used hydrogen peroxide 4% solution for the same process. Care must be taken for concentration and timing, because results showed that increasing of timing and concentration of the Hydrogen peroxide led to crumble (Hussain, et al. 2007).

In this work, length and diameter iron rods was chosen according to the species and size of the animals (Greene et al., 1993 and Hussain et al., 2007). Increasing the rods length of the fore and hind limbs must be taken into consideration for installation inside the wooden base.

Finally, the study helped in developing and improving of skeleton model technique for learning anatomy of veterinary medicine. It also provides skeletons models for rare and extinct animals for national museums.

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**Table (1): Time required for achievement of different processes of preparation of skeleton models**

	<b>Boiling (hr)</b>	<b>Degreasing (days)</b>	<b>Drying (hr)</b>	<b>Bleaching (hr)</b>
<b>Camel</b>	8	7	24	48
<b>Horse</b>	8	7	24	48
<b>Sheep</b>	6	7	24	48
<b>Dogs</b>	6	3	24	48
<b>Ostrich</b>	8	7	24	48
<b>Poultry</b>	2	2	24	48

**Table (2): Length and diameter of rods for achievement of skeleton models**

Animals	vertebral column Rod		Fore limb Rod		Hind limb Rod		Caudal vertebra		Wooden base		blades drilling mm
	L / cm	D/ mm	L / cm	D / mm	L / cm	D / mm	L / cm	D/m m	L/c m	D/c m	
Camel	230	24	120	12	150	12	60	Tin mental strips	30	90	2-12
Horse	160	24,16	115	12	135	12	40		230	85	2-12
Sheep	75	8	70	8	70	8	25		100	40	2-8
Dogs	60	8	40	6	40	6	25		65	35	2-6
Ostrich	165	12	–	–	140	12	20		150	85	2-12
Poultry	35	2	–	–	–	–	–		35	20	–



Fig (1): Horse skeleton



Fig (2): Ostrich Skeleton



Fig (3): Fowl Skeleton



Fig (4): Dog fore, and hind limb Skeletons