Methodology of Modern and Archaeological Bone Analysis: Special Reference to the Bone Sample of Garhwal Region (Uttarakhand)

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Abstract : Morphological study played an important role in the analysis of bone samples. In this paper we are discussing about the methodology of modern and excavated bone sample collected from different location of Garhwal Region. The taphonomic and archaeological bone sample for the present study were selected from dense cortical parts of long bones. A large number of modern bone sample of cattle (Bos indicus), Goat (Chapra jharal), and Pig were collected for the morphological study of this region.
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Key words : Taphonomic bone; Garhwal region; Archaeological bone.

Introduction

Human skeletal is much more than a structural framework for supporting our bodies. Bone tissue also contains a wide variety of information about the individual to when it attached (Price, 1989). The length and thickness of bone provides an indication of the size and strength of an individual. To establish the fundamental relationship between ancient diet and the inorganic constituent of bone (Lambert and Weydert-Homeyer; 1993) carried out a number of induced feeding experiments on rats. The chemistry of bone contains a number of signals about the environment in which in an individual lived. Bone chemistry has been used for chronological determinations (Cook and Heizer, 1965; Meddleton,1844; Oakley, 1955) for the study of fossilization (Barber, 1939; Cook, 1951) and of past climates and environments (Rottlander,1976).

Bone have been used to asses different aspects of behavioral activities of human and carnivores (De Niro and Epstein,1981; Binford, 1981; Klein and Cruz-Urible, 1984; Weinner et.al., 1993) for the study of fossilization (Cook, 1951) for chronological determination (Oakley, 1955). Bone is dynamic, cellular tissue with both structural and physiological functions. These activities require a complex substance. Bone tissue is essentially a network of mineralized, fibers composed of a matrix of organic collagen filled with inorganic calcium phosphate crystals. Bone contains three major compounds: a mineral fraction (bone ash), an organic matrix (collagen) and water.

The earliest studies of the history of skeletal organism were confined to evolutionary changes in skeletal morphology. These morphologic changes represent surface manifestations of biochemical evolutionary process. Chemical analysis of calcified skeletons has expended rapidly during the past twenty five years, undoubtedly because of advances in the general field of geochemistry and the development of more precise analytical techniques. Skeletal chemistry has a significant place in biochemical investigations because of its bearing on the fundamental problem of calcification itself and on the composition of modern carbonate sediments. Bones are usually the most common biologically formed materials in archaeological sites. If the bones are sufficiently well preserved to still contain some of the indigenous organic macromolecules, they can potentially be used to provide information on the age of bone by carbon -14 dating (Arnold &Libby, 1951).

Material and Methods

1. Collection and Selection of Bone Sample

The bone sample for the present study were collected from different modern and archaeological sites of mid-central Himalaya and adjoining areas skeletal remains of different ancient animal and human population will be collected from different type of archaeological occupational sites of this region after a systematic exploration and excavated sites. Taphonomic bone samples of different mammals will be collected from different zones of mid-central Himalaya and adjoining area through a proper exploration. These bones are scattered everywhere after natural death of the animals.

A large number of faunal remains were collected from different archaeological sites i.e. Koteshwar, Thapli, Purola and Ufalda. These sites were explorated and excavated by the department of history and archaeology H.N.B. Garhwal University, Srinagar (Garhwal), Modern taphonomic bone

samples were collected from various villages of Barkot and Bhatwari block in district Uttarkashi. In district Chamoli a large number of modern bone sample of cattle (Bos indicus), Goat (Chapra jharal), and Pig were collected. The human bone sample were collected from Roopkund, (Chamoli district) is a high altitude area, near about 17000 feet from sea level. The faunal remains which were collected. Skull. Humerus, Femur, Radius-Ulna, Tibia-Fibula, Metacarpals, Metatarsals, Ribs, Jaw, Pelvic girdle, Pectoral girdle, Servical, Thoracic, Sternum, Secrum etc.

2. Morphological Analysis and Recording

After the collection of all Archaeological and taphonomic remains will be analyzed morphologically help of osteologist or Zoologist to identifying different animal species present in a particular archaeological settlement. After the identifying measure the thickness and length if selected bone sample and record photographically and give a proper number sample name and sites name. After collection and morphological study bone sample were selected from dense cortical parts of the long bones for chemical analysis, as only shafts of long bones are found to be suitable for trace element analysis (Price et al 1985a, b and Grupe, 1988; Farswan and Price, 2002; Farswan and Nautiyal, 1997).

Before going chemical analysis all selected bone sample will be examined microscopically to see any post depositional digenetic alteration in bones. For such types of examination, sectioning bone is necessary. Only well preserved bone will be selected and separated for palaeodietary study.

(3) Cleaning, Pretreatment and Making Ash

After morphological analysis, bone sample were selected from dense cortical parts of the long bones for chemical analysis, as only shafts of long bones (Humerus, Femur, radius-Ulna, etc.) are found to be suitable for element analysis. Before going chemical analysis the bone sample were pretreated in laboratory through following steps.

All the flesh, tendon cartilage and any other non-bone tissue were removed from each of the bone samples. For the small amounts of residual tissue, the bones were cleaned by scraping with the help of sand marker or edge of a glass slide, as the glass is adequately hard and preferable to a knife, since metal objects can alter the chemical composition of bone.

The abraded clean samples were broken small pieces, a few millimeters in diameter and placed in different vials vials (20 cc polythene liquid scintillation vials with linear lids). Now the bone sample rinsed with de-ionized water, after some times the sample taken in sample tube and covered again with de-ionized water and clean in a ultrasonic bath for 30 minutes. The liquid is than drained. The process of sonication was repeated to cleans the samples perfectly.

After sonication with de-ionized water, the bone pieces in the same vials were covered with 1-Molar or 1-Normal acetic acid and allowed to settle at room temperature, and kept it as such from overnight. This was intended to remove much, even most, but not all of bone minerals in addition to past-depositional carbonate contamination. The acid washed bones were than rinsed de-ionized water and dried in a oven overnight at 80-90^0 C. But in case of modern bone checked after every half an hour because modern bone affected quickly becomes translucent, so they are removed after half an hour or less.

Now, after drying of bones, each sample was weighed into a labeled porcelain crucible. The crucibles were heated in a Muffle furnace at 725^{o}C for eight hours. After the crucibles were cooled, these were again weight loss, and indication of the amount of organic material in the bone.

For each sample, 50 milligrams of bone- ash were weighed into a disposal 16x25 mm Pyrex test tube. Now one ml of concentrated nitric acid was added to each test tube (pipette or micro pipette) and the tube were placed in aluminum heater of block on a hot plate and heated to 100-120^{o}C for one hour. For acid digestion of bone-ash the tubes of 16x25mm were used. The insoluble residue, cloudiness and colour in the solution after one hour were noticed as an indicator of contamination. After heating for one hour the samples were removed from the hot plate, allow cooling and diluted with 16 milliliter of 5% of nitric acid to a total volume of 17 milliliter.

Each tube were then covered tightly with plastic film or parafilm or the fingertip of a plastic glove and inverted ten times and shaken to ensure that the sample was well mixed. Finally, the solution was introduced directly into the Coupled Plasma Emission Spectrometry for elemental analysis (Bouman, 1979; Walsh, 1980). Before starting analysis, the Inductively Coupled Plasma Emission Spectroscopy (I.C.P) or Atomic Absorption Spectrophotometer (AAS) was calibrated with standared solution of different elements. The results obtained from the present study are calculated statistically to estimate the mean value and correlative ratios.

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