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Effects of Buried Environment on the Morphology and Trace Element Profile of Faunal Remains: An Experimental Study

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ABSTRACT

Present study was carried out mainly to know the effects of buried environment on morphology as well as elemental profile of the faunal remains. For this purpose we have collected 50 modern bone samples of goat, sheep and ox from different locations of the Garhwal region and these samples were buried in the ground in various places, at different levels of depth and pH as well. After four years all the buried bone samples were recovered and pretreated sequentially in the laboratory, examined morphologically and processed for getting the ash of each sample. Trace elements were estimated through spectrometry methods in Laboratory for archaeological chemistry, Wisconsin University, Madison, USA.

The morphological examination revealed that the bones buried in highly acidic and alkaline soil and at the level of 50 cm to 75 cm were proceeding towards the disintegration as they were recovered in bad condition, while other faunal remains which were buried in normal acidic and alkaline soil and beyond the level of 100 cm recovered in well preserved condition. However, elemental analysis also revealed that no any major changes in trace element profile has been observed among the faunal remains recovered in good conditions but in morphologically disintegrated faunal remains a significant change in the concentration level of different elements have been noticed. It clearly showed that both the factors are positively responsible for disintegration of archaeological remains.

INTRODUCTION

Archaeozoological studies have indicated that faunal remains are much more than a structural framework for supporting the body of an animal and similarly it is confirmed that the bone tissue also hold a large number of information about the individual to whom it is attached (Price 1989). Keeping in view of the same the faunal remains are being used for the reconstruction of palaeodiet and palaeo environment of past occupation. Therefore, dietary reconstruction has been an important aspect of archaeological and anthropological research.

To estimate the diet and dietary behavior of ancient human occupation, different workers have used various types of scientific and traditional methods. On the basis of scientific methods it is assumed that determination of the levels of particular trace elements preserved in bone provides a potential pathway for reconstructing the diet of extinct primate species and archaic human. Strontium, barium, magnesium, calcium and zinc are some most useful trace elements for dietary reconstruction. Reconstruction of palaeodiet through trace element analysis is estimated with the help of following basic principles as it has been established on the basis of a number of analytical studies:

- The higher concentration of Sr, Ca, Mg, Zn and lower values of Ba and Ba/Sr ratios clearly indicates the consumption of marine diet.
- Continuous intake of terrestrial diet deduces the concentration level of Mg, Sr and Zn in the animal bones while it increases the values of Ba and Ba/Sr ratios.
- Lower values of Mg in animal bone indicate the consumption of terrestrial diet, while higher values of the same indicate the consumption of marine diet.
- Carnivores generally have higher concentration of Zn in their bone than the herbivores.

- Higher ratio of bone Sr-To-Ca and Ba-To-Ca represent a greater percentage of vegetable food in their diet and lower ratio of the same indicate greater percentage of meat in their diet.

A survey of literary archaeological data on palaeodiet revealed that a lot of work has been done on archaeological faunal and human remains from different types of archaeological sites of the world (Smith and Field, 1963; Atkins, 1976; Bratter et al. 1977; Underwood, 1977; Wessen et al. 1978; Walsh and Howie, 1980; Parker and Toots, 1980; Lambert et al. 1982 & 1993; Geidel, 1982; Sillen and Kavanagh, 198; Casey et al. 1982; Gilbert, 1977, 1985; Katzenberg and Schwarcz., 1984; Beck, 1985; Alfrey, 1986; Runia, 1987a;, Ambrose, 1987;, Byrne and Paris, 1987;, Tuross et al. 1989; Sealy and Sillen, 1988; Antoine et al. 1988; Grupe, 1988; Schoeninger, 1989; Tuross et al. 1989; Price, 1989; Morgan and Schoeninger, 1989; Grupe and Piepenbrink, 1989; Burton and Price, 1990, 1991; Ezzo, 1994; Pate, 1994; Gilbert et al. 1994; Burton et al. 1999; Schutkowski and Herrmann, 1999; Farswan, et. al (2015, 2014); Farswan and Pharswan (2015, 2013, 2009); Farswan (2013, 2012, 2010, 2008, 2007, 2003); Pharswan and Farswan (2012, 2011); Farswan and Singh (2015, 2012, 2009, 2007, 2006, 2005); Farswan and Price, 2002 etc.

But after studying the aforesaid studies, right now it has to be clarifying that for conducting the palaeodietary investigation the faunal remains recovered from different types of archaeological sites should be in good and well preserved condition. Present study was therefore carried out to know the effects of buried environment on morphological as well as elemental profile of the faunal remains which can be used as base line data.

MATERIALS AND METHODS

For the present study we have collected 50 modern bone samples of goat, sheep and ox from different locations of the Garhwal. These samples were buried in the ground in for places, at different levels of depth (i.e. 50, 80, 120 & 150 cm. levels) and different levels of pH as well at different region four years before the recovery of faunal remains. Selection of ground for site-A, B, C, D and E were selected on the basis of nature of soil such as just closed to the activity area of modern settlement, in barren land, in water logging land and in agricultural land respectively.

After four years all the buried bone from the respective sites were recovered and examined morphologically in the laboratory. The long bone samples were broken to expose the medullary cavity, and all the exposed surfaces were then abraded with the Dremel “moto tool” to remove non bone tissues/external contamination

The abraded clean samples were broken into small pieces, a few millimeters in diameter, placed in a vial (20 cc polythene liquid scintillation vials with linear lids), rinsed with de-ionized water, covered again with de-ionized water and allowed in a Ultrasonic bath for thirty minutes. The liquid was then drained and after sonication with de-ionized water, the bone pieces in the same vials were covered with 1-Molar or 1-Normal acetic acid solution respectively and allowed to sit at room temperature for overnight. This was intended to remove much, even most, but not all of bone mineral. The acid washed bone were then rinsed with de-ionized water and dried in an oven at 80-90 degree Celsius for overnight.

From the dried bones, approximately one and half gram (1.5 gm.) of each sample was weighed into a pre-weighed as well as pre-labeled porcelain crucible. The weight of empty crucible and the weight of crucible plus bone were also recorded. The crucibles were then placed into a Muffle at 725-degree Celsius for eight hours to ash the samples. After 08 hours they were allowed to cool and weighed again with their ash contents, and the percentage of weight loss was determined for the purpose of indication of the amount of organic material in the bone.

For each sample, 50 milligram (0.50 gram) of bone ash was weighed into a disposable 16x25 mm Pyrex test tube. A reference controlled sample was also included in addition to the experimental samples. One milliliter of concentrated nitric acid is added to each test tube (using micropipette) and the tubes are placed in an aluminium heater block on a hot plate and heated to 100-120 degree Celsius for one hour. Later on, these samples were removed from the hot plate, allowed to cool, and diluted with 16 milliliters of 5% nitric acid to a total volume 17 milliliter. Each tube was then covered tightly with plastic film or parafilm or the fingertip of a plastic glove, and inverted ten times and shaken for well mixing of sample.

Finally the solution was then introduced directly into the spectrophotometer for elemental analysis. Elemental analysis was done with the help of Laboratory for archaeological chemistry, Wisconsin University, Madison, USA

Results and Discussions

Results of the hydrogen ion concentration estimated in different levels of buried grounds are presented in Table-1 and Figure-1 which is indicating that the conditions of soil at site A, C and E were slightly acidic to moderately acidic while at site B and D it was slightly alkaline to moderately alkaline.

The morphological examination of faunal remains revealed that the bones buried in highly acidic and alkaline soil and at the level of 50 cm to 80 cm were proceeding towards the disintegration as they were recovered in bad and contaminated condition, while other faunal remains which were buried in normal acidic and alkaline soil and beyond the level of 100 cm recovered in well preserved condition. Besides this samples recovered from site B and D were also proceeding towards the contamination and it may be due to the effects of soil pH.

Earlier investigations on palaeodietary studies indicated that microbial activities are responsible for changing the trace element profile in some extent (Grupe and Piepenbrink 1989). However, it has also been observed by Aitkens (1976) that there are so many environmental factors which adversely affect the distribution of zinc in human skeleton. Meanwhile strontium change and crystallinity change in taphonomic and archaeological bones are well defined by the Tuross et.al. (1989).

In present study result obtained through spectrophotometer are calculated statistically and mean values of different elements for different experimental faunal remains are presented in Table-2 to 6 and Figures-2 to 6. The elemental analysis revealed that no any major changes in trace element profile was observed among the faunal remains recovered in good conditions but in morphologically disintegrated faunal remains, a significant change in the concentration level of different elements have been noticed (in site-A to E) at different buried levels which clearly showed that both the factors i.e. soil pH and as well as levels of buried site are positively responsible for disintegration of archaeological remains.

At the outset, it is to submit that we want to know the changes in the trace element profile and process of mineralization in the soil of different buried site which are still under analytical process. After getting the results of the soil trace element analysis the correlation of mineralization process between faunal remains and soil of the site can be established.

Table1. *Hydrogen Ion Concentration (pH) in different Locations and levels of Buried Sites*

Buried Site	Surface	50 cm	80 cm	120 cm	150 cm
Site-A	6.65	5.52	5.25	6.95	6.75
Site-B	8.25	7.56	7.56	7.56	7.56
Site-C	5.75	5.05	5.35	6.54	6.65
Site-D	8.12	7.58	7.75	7.85	7.98
Site-E	6.65	5.52	5.25	6.95	6.75

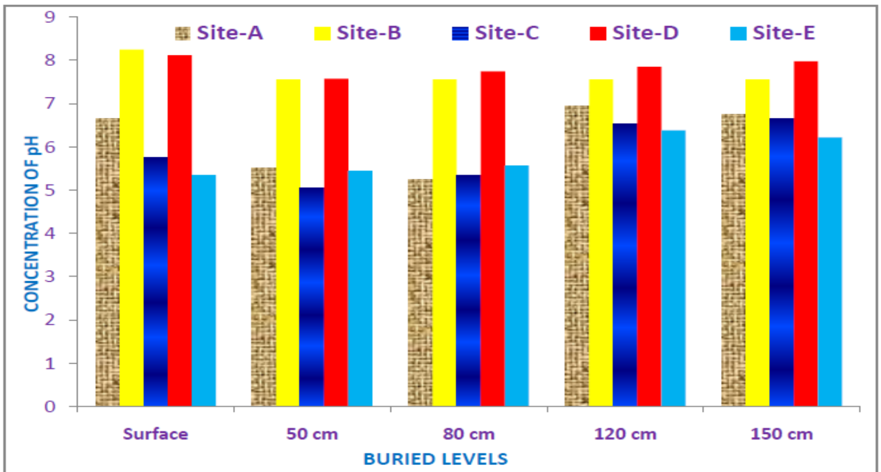

Figure-1 Hydrogen Ion Concentration (pH) in Different Locations and Levels of Buried Sites

Table2. *Concentration of Trace Elements in the faunal remains recovered from surface levels of Buried sites*

Trace Elements	Reference	Site-A	Site-B	Site-C	Site-D	Site-E
Ca (x 1000)	397.25	484.45	385.57	475.53	398.87	479.89
Sr	276.12	375.55	235.5	362.06	258.42	360.21
Ba	165.52	239.86	188.66	283.43	139.55	248.75
Mg (x 100)	192.254	163.54	189.29	157.87	188.5	155.2
Zn	75.25	108.33	66.22	115.21	85.02	119.5

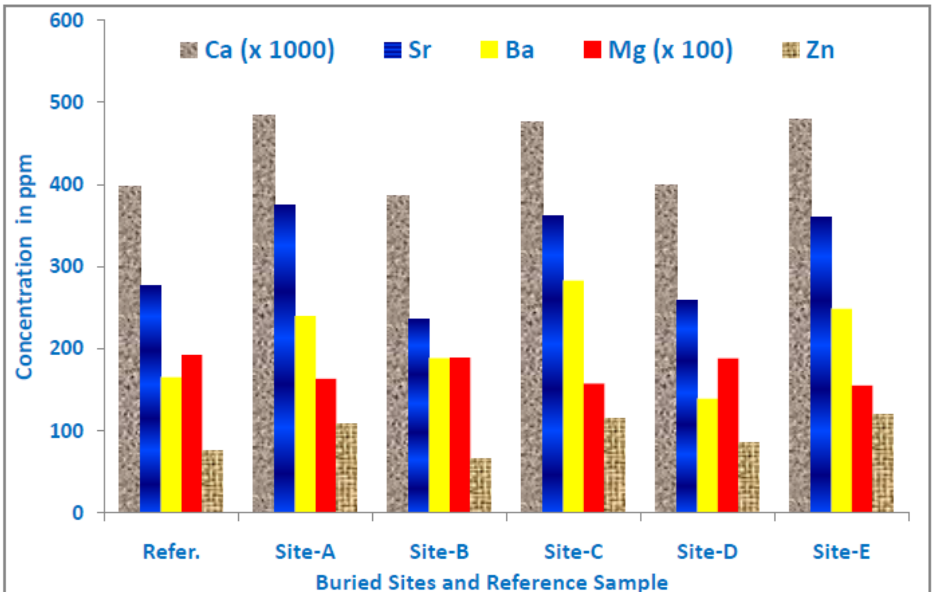

Figure-2 Concentration of Trace Elements in the Faunal Remains Recovered from Surface Levels of different Buried Sites

Table3. *Concentration of Trace Elements in the faunal remains recovered from 50 cm Levels of Buried sites*

Trace Elements	Reference	Site-A	Site-B	Site-C	Site-D	Site-E
Ca (x 1000)	379.352	485.33	361.25	460.57	357.52	444.23
Sr	395.54	268.42	398.22	298.22	398.22	246.21
Ba	265.75	299.55	208.26	328.66	198.66	304.24
Mg (x 100)	252.25	425.48	254.34	443.85	231.25	464.51
Zn	78.5	118.25	92.22	103.42	82.42	108.08

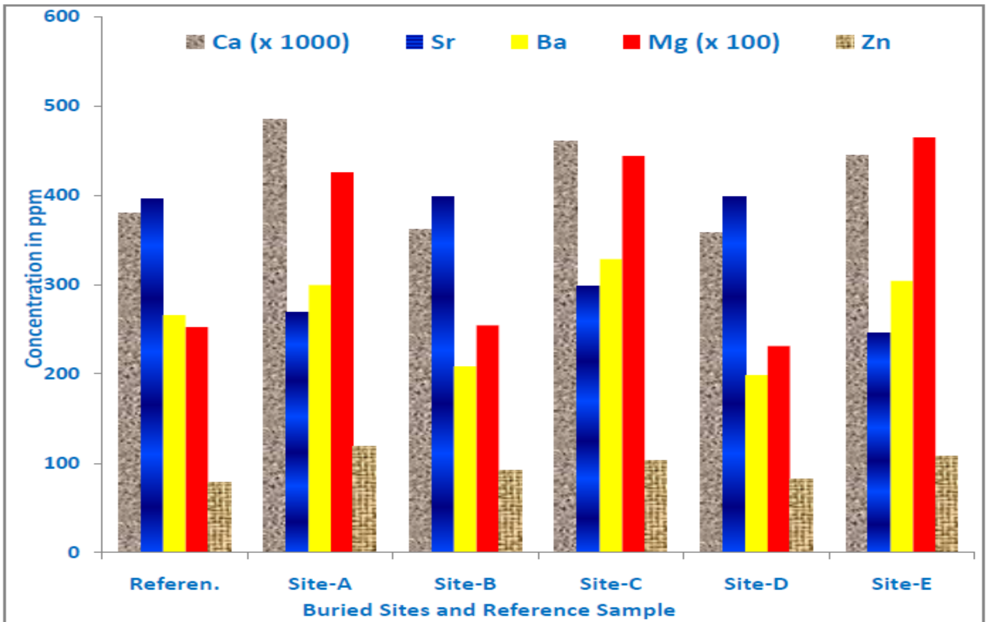

Figure-3 Concentration of Trace Elements in the Faunal Remains Recovered from 50 cm Levels of different Buried Sites

Table4. *Concentration of Trace Elements in the faunal remains recovered from 80 cm Levels of Buried sites*

Trace Elements	Reference	Site-A	Site-B	Site-C	Site-D	Site-E
Ca (x 1000)	395.85	472.16	394.66	442.05	398.57	472.68
Sr	378.54	269.58	365.5	299.5	398.43	245.72
Ba	175.75	286.93	169.57	292.57	188.86	269.57
Mg (x 100)	188.55	363.54	199.86	312.58	189.29	361.68
Zn	99.53	112.25	101.06	102.95	86.22	114.6

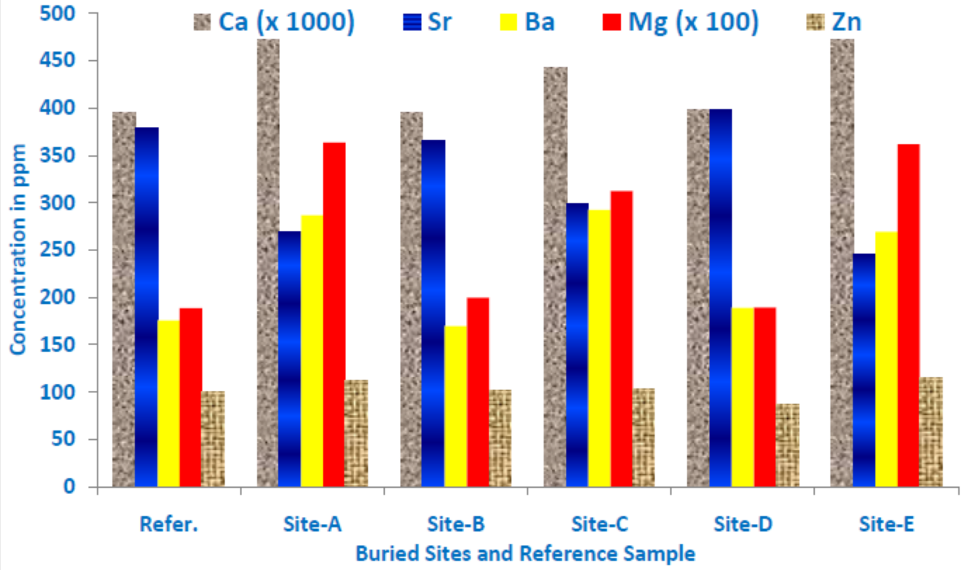

Figure-4 Concentration of Trace Elements in the faunal Remains Recovered from 80 cm Levels of different Buried Sites

Table5. *Concentration of Trace Elements in the faunal remains recovered from 120 cm Levels of Buried sites*

Trace Elements	Reference	Site-A	Site-B	Site-C	Site-D	Site-E
Ca (x 1000)	391.25	487.89	398.85	437.32	415.37	463.51
Sr	485.63	325.21	456.45	322.22	509.42	373.1
Ba	159.82	238.65	139.1	283.43	185.63	256.75
Mg (x 100)	197.36	357.2	186.5	349.26	197.88	367.51
Zn	87.5	112.5	109.1	115.2	65.22	117.25

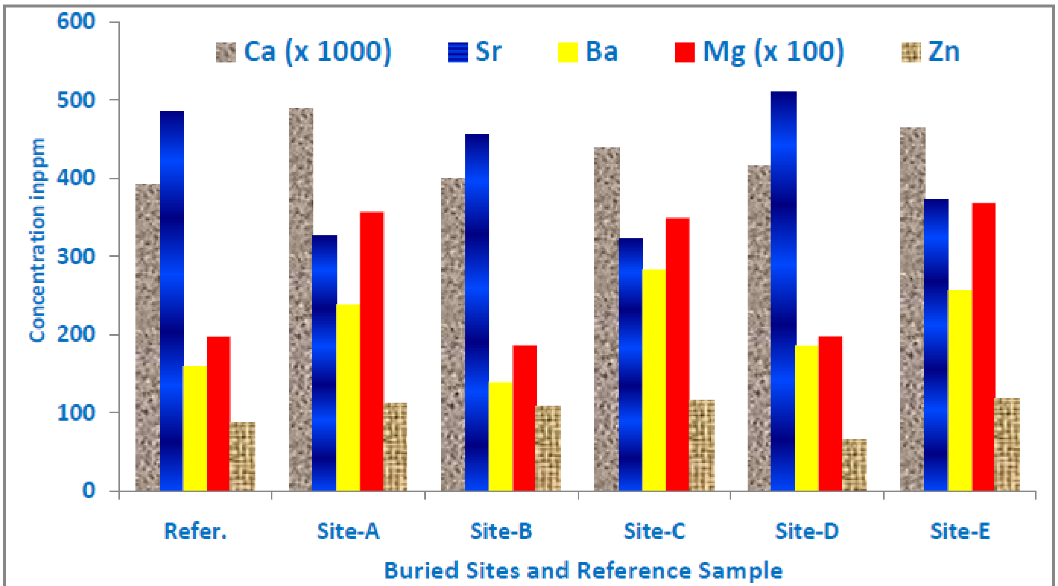

Figure-5 Concentration of Trace Elements in the faunal Remains Recovered from 120 cm Levels of different Buried Sites

Table6. *Concentration of Trace Elements in the faunal remains recovered from 150 cm Levels of Buried sites*

Trace Elements	Reference	Site-A	Site-B	Site-C	Site-D	Site-E
Ca (x 1000)	386.25	345.68	385.15	343.89	399.57	352.85
Sr	433.2	455.22	439.5	498.5	455.43	467.1
Ba	67.82	139.5	147.57	173.57	185.86	241.92
Mg (x 100)	249.36	259.68	237.58	239.86	236.29	237.53
Zn	102.32	105.6	108.95	105.06	107.22	106.56

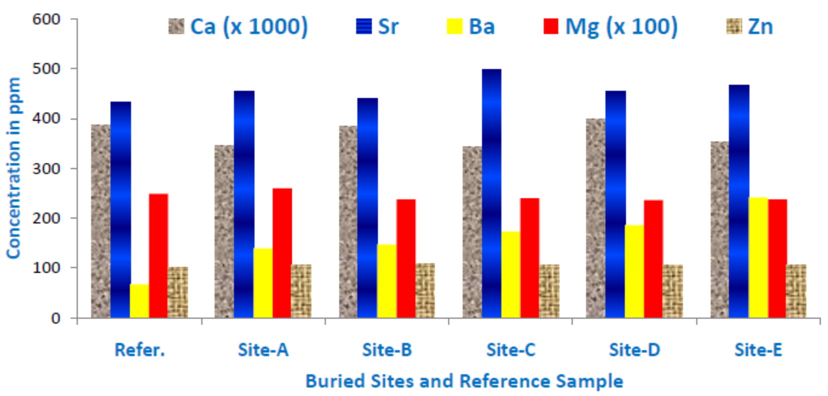

Figure-6 Concentration of Trace Elements in the Faunal Remains Recovered from 150 cm Levels of different Buried Sites

REFERENCES

[1] Aitkens, J.M. 1976. Factors Affecting the Distribution of Zinc in the Human Skeleton, *Calcified Tissue Research* 20: 23-30.

[2] Alfrey, A. C. 1986. Aluminum, *in Trace Elements in Human and Animal Nutrition*, Vol.2, (W. Mertz Ed.), pp. 399-413. Academic Press, Orlando.

[3] Ambrose, S.A.1987. Chemical and Isotopic Techniques of Reconstruction in Eastern North America, *in Emergent Horticultural Economics of the Eastern Woodlands*, (W. F. Keegan Ed.), pp. 87-107. Center for Archaeological Investigations, Occasional Paper No.7. Carbondale.

[4] Antoine, S. E., Pollard, A.M., Dresser, P.Q. and Whittle, A.W.R. 1988. Bone Chemistry and Dietary Reconstruction in Prehistoric Britain: Examples from Orkney, Scotland, *Proceeding of the 26th International Archaeometry Symposium*, pp. 101-106.

[5] Beck, L.A.1985. Bivariate Analysis of Trace Elements in Bone, *Journal of Human Evolution* 14: 493-502.

[6] Bratter, P., Gawlik, D., Lausch, J. and Rosick, U. 1977. On the Distribution of Trace Elements in Human Skeletons, *Journal of Radio analytical Chemistry* 37: 393-403.

[7] Burton, J.H. and Price, T.D. 1990. The Ratio of Barium to Strontium as a Palaeodietary Indicator of Consumption of Marine Resources, *Journal of Archaeological Science* 17: 547-557.

[8] Burton, J. H and Price, T. D. 1991. Paleodietary Applications of Barium values in Bone. *in Proceedings of the 27th International Symposium on Archaeometry*, Hiedelberg,1990 (E. Pernicka and G. A.Wagner Eds.), pp. 787-795.

[9] Burton, J. H., Price, T. D. and Middleton, W. D. 1999. Correlation of Bone Ba/Ca and Sr/Ca due to Biological Purification of Calcium, *Journal of Archaeological Science* 26: 609-616.

[10] Byrne, K. B. and Paris, D. C. 1987. Reconstruction of the Diet of the Middle Woodland Amerindian Population at Abbot Farm by Bone Trace-element Analysis, *American Journal of Physical Anthropology* 74: 373-384.

[11] Casey, C. E., Guthrie, B. E. and Mckenzie, J. M. 1982. Trace Elements in Tissue from New Zealanders, Compilation of Published data, *New Zealand Medical Journal* 10: 768-771.

[12] Ezzo, J. A.1991. Dietary change at Grasshopper Pueblo, Arizona: The evidence from Bone Chemistry Analysis, *Ph.D. Dissertation*, University of Wisconsin, Madison.

[13] Ezzo, J. A.1994.Putting the "Chemistry" Back into Archaeological Bone CHemistry Analysis: Modeling Potential Palaeodietary Indicators, *Journal of Anthropological Archaeology* 13: 1-34

[14] Farswan, Y.S., Singh, H. and Pharswan, J.S. (2015). Effects of Buried Environment on Trace Element Profile of Bones from Experimental Himalayan Domestic Goat (Capra Jharal) ***Periodic Research VOL.-IV***, ISSUE-II, November-2015, pp.:115-122.

[15] Farswan, Y.S. and Singh Jaibir (2015). Study of Preservation Status and Dietary Reconstruction in the Human Remains Recovered from Roopkund Lake through Chemical Analysis of Faunal Remains, ***Journal of Chemistry and Chemical Engineering, USA***, Vol.9:15-22.

[16] Farswan, Y.S. and Pharswan, J.S. (2015). Effects Of Induced Feeding on Trace Element Profile and Isotopic Ratios of Carbon in Himalayan Domestic Goat *(Capra jharal)*, ***The Mirror*** **(An Annual Journal of History),** Vol.2: 75-81.

[17] Farswan, Y.S. Pharswan J.S. and Rawat H.S. (2014). Effects of Buried Environment on the Morphology and Trace Element Profile of Faunal Remains: An Experimental Study, ***Asian Man (The): An International Journal*****:** Vol. 8(2): 129-134.

[18] Farswan, Y.S. and Pharswan, J.S. (2013). Reconstruction of Intensity of Occupation through Trace element analysis of Archaeological soils from Garhwal Himalaya Uttarakhand, in Himalayee Itihaas ke Vividh Aayaa**m (Proceedings of Uttarakhand Itihaas Avam Sanskriti Parishad)**, Anamika Publishers and Distributers (Pvt.), New Delhi, pp. 104-115.

[19] Farswan, Y.S. (2013). Comparative Study of Occupational Intensity in modern Settlement of Alaknanda and nandakini Valley of Chamoli, Uttarakhand, India, ***Proceedings of Indian History Congress,*** *73nd Session,* held at University of Mumbai, Bombay, 2012, pp. 1279-1286.

[20] Pharswan, J.S. and Farswan, Y.S. (2012). Study of Occupational Intensity in Modern Settlement of Nandakini Valley, District-Chamoli, Uttarakhand, India, ***Asian Man (The):*** **An** ***International Journal*****:** Vol. 6(2): 121-126.

[21] Farswan, Y.S. (2012). Effects of Buried Environment on the Bones of a Modern Ox (*Boss indicus*)-II: Study of Isotopic Analysis, ***Research Journal of Social and Life Sciences,*** Vol.-XIII(II): 305-309.

[22] Farswan, Y.S. and Singh J. (2012). Effects of Buried Environment on the Bones of a Modern Ox (*Boss indicus)-I*: Study of Trace Element Analysis, ***Research Journal of Arts, Management and Social sciences,*** VII-I (4): 191-198.

[23] Pharswan, J.S. Farswan, Y.S. and Negi, J.S. (2012). Elemental Analysis of Archaeological soil Samples of Khajnawar, Through Atomic Absorption Spectrophotometer (AAS) **in Bharti, P.K. and Chauhan A. Eds.** ***Soil Quality and Contamination,*** Discovery Publishing House Pvt. Ltd., New Delhi, pp:32-40.

[24] Farswan, Y.S. (2012). Study of Preservation Status and Dietary Reconstruction in the Human Remains recovered from Roopkund Lake, through Chemical Analysis, ***Proceedings of Indian History Congress,*** *72nd Session*, held at Panjabi University, Patiala, 2011, pp. 1279-1288.

[25] Pharswan, J.S. and Farswan, Y.S. (2011). Role and Utility of Trace Elements in Palaeodietary Reconstruction, ***New York Science Journal***, 4(11): 43-48.

[26] Pharswan, J.S. and Farswan Y.S. (2011). Roopkund Ke Nar Kankal: Etihasik avam Vaigyanik Vivran, ***Samaj Vigyan Shodh Patrika,*** Vol.1:XIII:96-98.

[27] Farswan Y.S. (2010). Methodology and Techniques of Soil Analysis in Archaeology, ***Samaj Vigyan Shodh Patrika***, Vol.2: XII:15-19.

[28] Farswan Y.S. and Jaibir Singh (2009). Trace Element Analysis in Archaeological Soils from Garhwal Himalaya: To Reconstruct the Intensity of Occupation, ***Research Journal of Social and Life Sciences***, Vol.7 (4):156-164.

[29] Farswan, Y.S. and Pharswan, J.S. (2009). Elemental Analysis and Estimation of Isotopic Ratios of Carbon in Archaeological Faunal Remains from Mid-Central Garhwal Himalaya: A note for Palaeodietary and Palaeo environmental Reconstruction, ***Proceedings of First Uttaranchal History and Culture Association***, held in 2007, Vol-I, pp. 25-43.

[30] Farswan, Y.S. (2008). Reconstruction of Base-Line Data of Intensity of Occupation in Modern settlements of Garhwal Himalaya through elemental analysis of soil, ***Proceedings of Indian History Congress,*** **68rd Session,** held at Delhi University, Delhi, 2007, pp. 1310-1321.

[31] Farswan Y.S. (2007). Reconstruction of Palaeodiet and Environmental Condition of Ancient Population of Mid-Central Garhwal Himalayas through the Estimation of Trace Elements and Isotopic Ratios of Carbon in the Human and Animal Remains, ***International Journal of Essential Sciences***, Vol.1(1): 53-68.

[32] Farswan, Y.S. and Jaibir Singh (2007). Phosphorus Analysis in the Soils of Central Himalaya. ***The Journal of the Meerut University History Alumni*****,** Vol.-IX (No.5): 128-131.

[33] Farswan, Y.S. and Jaibir Singh (2006). Application of Scientific Analysis in Reconstructions of Past history: With Special Reference to Inhabitants of Mid-Central Garhwal Himalayan. ***Proceedings of National Seminar, Resource Appraisal, technology Application and Environmental Challenges in Central Himalaya,*** (Rawat, M. S. S. Ed.), Vol.II: 225-234.

[34] Farswan, Y.S. and Jaibir Singh (2005). Reconstruction of Occupational Intensity through Elemental Analysis of Anthropogenic Soils from the Modern Settlement of Garhwal Himalaya, ***Journal of the Meerut University History Alumni,*** **Vol.**V:492-499.

[35] Farswan, Y.S. (2003). Chemical Analysis of Anthropogenic Soils from the modern settlements of Garhwal Himalaya,

Proceedings of Indian History Congress, 3rd Session, Amritsar, 2002, pp.1117-1120.

[36] Farswan, Y.S. and Price, T. D. (2002). Reconstruction of Palaeodiet through Trace Element Analysis of Archaeological Faunal Remains, ***Indian Journal of Environment and Ecoplanning,*** Vol.6 (2): 197-208.

[37] Geidel, R.A. 1982. Trace Element Studies from Mississippian Skeletal Remains: Findings from Neutron Activation Analysis, *Masca Journal* 2:13-16.

[38] Gilbert, R.I. 1977. Applications of Trace Element Research to Problems in Archaeology, *in Biocultural Adaptation in Prehistoric America* (R.L. Blakely Eds.), pp. 85-100. University of Georgia, Athens.

[39] Gilbert, R. I.. 1985. Stress, Paleonutrition, and Trace Elements, *in The Analysis of Prehistoric Diets,* (R.I.Gilbert and J. H. Mielke Eds.), pp. 339-358. Academic Press, Orlando.

[40] Gilbert, C., Sealy, J. and Sillen, A. 1994. An Investigation of Barium, Calcium and Strontium as Palaeodietary Indicators in the Southwestern Cape, South Africa, *Journal of Archaeological Science* 21: 173-184.

[41] Grupe, G. 1988. Impact of the Choice of Bone Samples on Trace Elements Data in Excavated Human Skeletons, *Journal of Archaeological Science* 15:123-129.

[42] Grupe, G. and Piepenbrink, H. 1989. Impact of Microbial Activity on Trace Element Concentrations in Excavated Bones, *Applied Geochemistry* 4: 293-298.

[43] Katzenberg, M. A. and Schwarcz, H. P. 1984. Dietary change in Southern Ontario Prehistory: Evidence from Strontium and Stable Isotopes of Carbon and Nitrogen, *American Journal of Physical Anthropology* 63: 177.

[44] Lambert, J. B., Vlasak, S. M. and Thometz, A. C. 1982. A Comparative of Study of the Chemical Analysis of Ribs and Femurs in Woodland Populations, *American Journal of Physical Anthropology* 59: 289-194.

[45] Lambert, J. B. and Weydert-Homeyer, J. M. 1993. The Fundamental Relationship Between Ancient Diet and the Inorganic Constituents of Bone as Derived from Feeding Experiments, *Archaeometry* 35(2): 279-294.

[46] Morgan, M.E. and Schoeninger, M.J. 1989. Zinc and Strontium as Dietary Indicator in a Modern Tropical Community, *American Journal of Physical Anthropology* 78: 276.

[47] Parker, R. B. and Toots, H. 1980. Trace Elements in Bones as Palaeobiological indicator, *in Fossils in the Making,* (A. K. Behrensmeyer and A. P. Hill Eds.), pp. 197-207. University of Chicago, Chicago.

[48] Pate, F. D. 1994. Bone Chemistry and Palaeodiet, *Journal of Archaeological Method and Theory* 1(2): 161:209.

[49] Price, T. D. (1989). *The Chemistry of Prehistoric Human Bone*, Cambridge University Press, Cambridge.

[50] Runia, L. T. 1987a. The Chemical Analysis of Prehistoric Bones: A Palaeodietary and Eco-archaeological Study of Bronze Age West-Friesland, *Bar International Series* 363: 234.

[51] Schoeninger, M. J. 1989. Reconstructing Prehistoric Human Diet, *Homo* 39: 78-99.

[52] Schutkowski, H. and Herrmann, B. 1999. Diet, Status and Decomposition at Weingarten: Trace Element and Isotope Analyses on Early Mediaeval Skeletal Material, *Journal of Archaeological Science* 26: 675-685.

[53] Sealy, J. C. and Sillen, A. 1988. Sr and Sr/Ca in Marine and Terrestrial Food Webs in the South-Western Cape, South Africa, *Journal of Archaeological Science* 15: 425-438.

[54] Sillen, A. and Kavanaugh, M. 1982. Strontium and Palaeodietary Research: A Review, *Year Book of Physical Anthropology* 25: 67-90.

[55] Smith, B. S. W. and Field, A. C. 1963. Effect of Age on Magnesium in Bones, *British Journal of Nutrition* 17: 591-600.

[56] Tuross, N., Behrensmeyer, A. K. and Eanes, E. D. 1989. Strontium Change and Crystallinity Change in Taphonomic and Archaeological Bones, *Journal of Archaeological Science* 16: 661-672.

[57] Underwood, E. J. 1977. *Trace Elements and Animal Nutrition,* Academic Press, New York.

[58] Walsh, J. N. and Howie, R. A. 1980. An Evaluation of the Performance of an Inductively Coupled Plasma Source Spectrometer for the Determination of the Major and the Trace constituents of Silicate Rocks and Minerals, *Mineralogical Magazine* 43: 967-974.

[59] Wessen, G., Ruddy, F. H., Gustafson, C. E. and Irwin, H. 1978. Trace Element analysis in the Characterization of Archaeological Bone, *in Archaeological Chemistry* Vol. II, American Chemical Society. pp.99-108.

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