

ENERGY DISPERSIVE X-RAY ANALYSIS OF OVINE SCAPULAR CARTILAGE

R. Gangadhar, Kaleem Ahmed Jaleeli and Adeel Ahmad

Biophysics Unit, Department of Physics, Nizam College (Autonomous), Osmania University,
Hyderabad – 500001, India

E-mail: dr_adeelahmad@yahoo.com

Abstract: This paper is concerned with the organic and inorganic composition of Ovine scapular cartilage. Energy dispersive X-ray analysis is made to study the percentage of elements. The variation in the percentage of elements suggests inhomogeneity in molecular composition.

Keywords: Ovine, Scapular cartilage, EDXA, Sun dried.

1. Introduction

Energy dispersive X-ray spectroscopy (EDS or EDX) is an analytical tool used for the analysis of elements or chemical characterization of a sample. It is a type of spectroscopy, in which the investigation of a sample is done through interactions between electromagnetic radiation and matter, analyzing x-rays emitted by the matter in response to being hit with charged particles. Its characterization capabilities based on the principle that each element has a unique atomic structure, allowing x-rays that are characteristic of atomic structure of the element to be identified.

Boyde and Shapiro [1] analysed isolated cells of matrix fragments of freeze fractured and freeze dried growth plate using the technique of EDX. They reported that the early cartilage matrix accumulates Ca and the role of cells is to elevate the matrix Ca and P concentration.

Shapiro and Boyde [2] studied the concentrations of elements in avian growth cartilage by electron probe x-ray emission microanalysis (EDX) and proposed that the transfer of phosphorus from cell to matrix is a rate-limiting step in mineralization. They suggested that a phosphorus-related calcification defect prevents growth and interlocking of the apatite crystallites.

Vittur *et al* [3] studied elemental composition of growth plate cartilage from calf scapula by means of SRIXE and obtained X-ray emission spectra from the resting, hypertrophic and calcified regions of cartilage. They found evidence for a homogeneous distribution of the

elements in resting cartilage compared to changes in local concentration of some atoms in the hypertrophic-calcified tissue.

A perusal of literature reveals no elemental analysis of Ovine scapular cartilage. In view of this, elements present in ovine scapular cartilage are identified qualitatively and also quantitatively by using the technique of electron dispersive x – ray spectroscopy (EDXS).

2. Materials and Methods

Ovine scapula was purchased from beef shop after 4 to 5 hours of slaughtering. The samples were cleaned removing the flesh attached to them and sun dried. Specimens were prepared by cutting them in flat rectangular shape, which were suitable for the EDX instrument.

Specimens were mounted on aluminum stubs using double adhesive tape, coated with gold in Vacuum evaporated Hitachi HUS – 5GB and EDX studies were carried out on OXFORD-LINK-ISIS EDX fitted to Hitachi S-520 scanning electron microscope.

The Spot Mode operation was used for elements suspected to be concentrated in very small regions. For this purpose, seven spots were selected. SEM micrograph with the selected area of measurement was shown in Fig. 1 and EDX spectra were presented in Fig. 2. The data on elements detected and their concentrations measured at 7 different spots of ovine scapular cartilage was presented in Table 1.

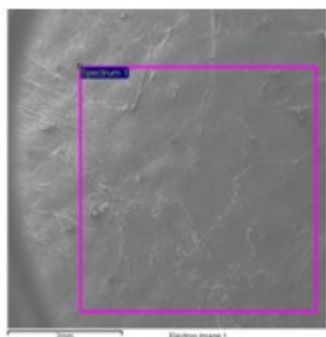


Fig. 1. SEM micrograph of ovine scapular cartilage

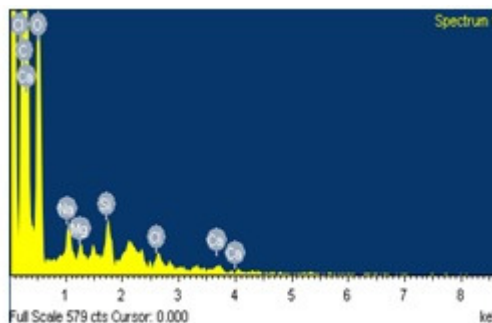


Fig. 2.1. EDX spectrum of ovine scapular cartilage at position 1

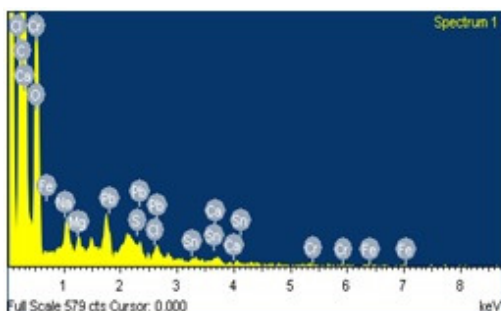


Fig. 2.2. SEM micrograph of ovine scapular cartilage at position 2

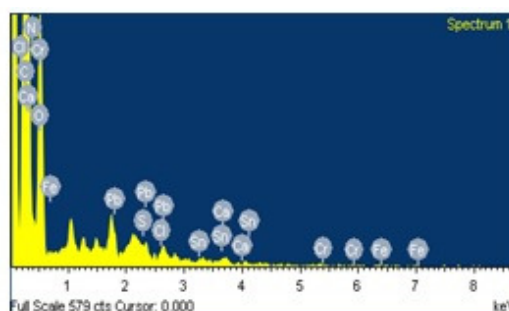


Fig. 2.3. EDX spectrum of ovine scapular cartilage at position 3

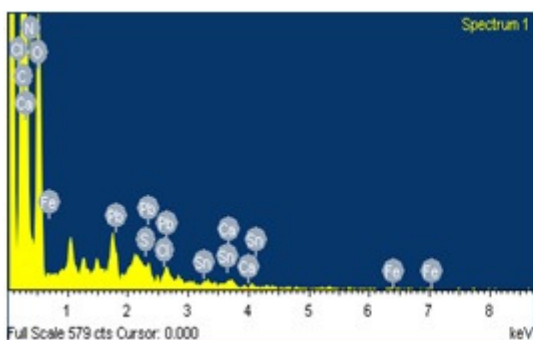


Fig. 2.4. EDX spectrum of ovine scapular cartilage at position 4

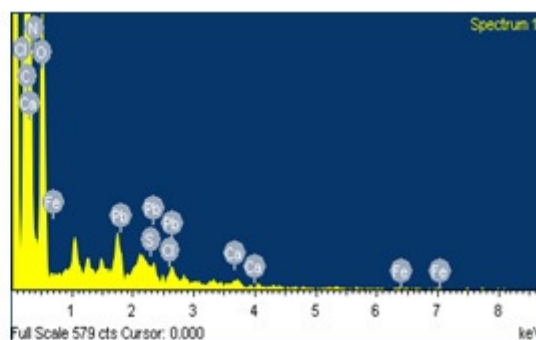


Fig. 2.5. EDX spectrum of ovine scapular cartilage at position 5

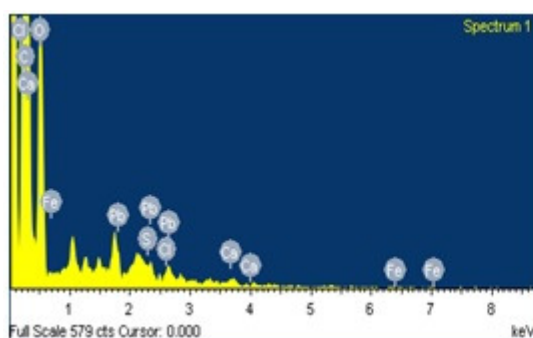


Fig. 2.6. EDX spectrum of ovine scapular cartilage at position 6

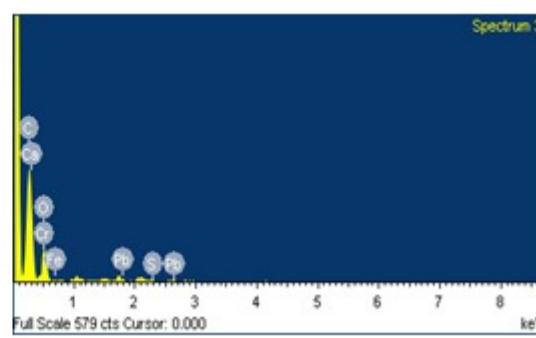


Fig. 2.7. EDX spectrum of ovine scapular cartilage at position 7

Table 1 - Elements of ovine scapular cartilage in weight Percentage

Element	Weight %						
	Spectrum 1	Spectrum 2	Spectrum 3	Spectrum 4	Spectrum 5	Spectrum 6	Spectrum 7
C K	60.29	59.28	53.51	46.99	63.04	59.95	69.28
O K	33.19	32.36	33.24	27.63	36.60	34.54	33.40
N K	-	-	25.78	14.46	-5.53	-	-
Na K	1.38	1.46	-	-	-	-	-
Mg K	0.64	0.67	-	-	-	-	-
Si K	2.12	-	-	-	-	-	-
Cl K	1.34	1.35	1.19	1.06	1.49	1.40	-
Ca K	1.04	1.23	1.09	0.97	1.16	1.09	0.73
S K	-	0.45	0.40	0.35	0.49	0.46	0.21
Cr L	-	-1.16	-28.28	-	-	-	10.43
Fe L	-	5.26	13.88	9.24	2.48	2.31	-9.75
Sn L	-	-1.15	-1.01	-0.90	-	-	-1.24
Pb M	-	0.24	0.21	0.19	0.26	0.25	-3.06

The negative value means that the elemental signal level is even lower than the back ground noise (i.e. continuum X-rays - Bremsstrahlung)

3. Results and Discussion

Table 1 reports the data on 13 different elements present in ovine scapular cartilage determined by employing energy dispersive x-ray analysis. The elements are C, N, O, Na,

Mg, Si, Cl, Ca, S, Cr, Fe, Sn and Pb. These elements are detected at 7 different areas of the same cartilage samples. The concentration of the elements is in weight percentage. It can be noted that the distribution of the elements is not uniform. It means that molecular composition within the specimen is highly inhomogeneous. Of all elements analysed C, O and N, in general, are found to be more in quantity, while other elements are less. The percentage of C is more i.e. 46% to 69 %. Oxygen is the second highest quantity present in cartilage, when compared with the other elements. It ranges between 28% and 37%. N is in good amount, but not detected at all selected points. The next element is Fe, the weight percentage of which ranges between 2 and 13, considering different areas of measurement. The percentage of Ca and Cl is around 1. Percentage of Pb is in the range of 0.19 to 0.26. The element sulfur ranges between 0.35% and 0.49%. The other elements are in negligible, but not found in some areas of the samples and most of the cases their signal level is even lower than the background noise.

The EDX analysis suggests the presence of C, O and N relatively in large quantity might be concerned with protein—the collagen. Further, the inorganic content of the cartilage under study is very low.

References

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