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Short Communications

UTILIZATION OF THERMAL ANALYSIS IN GORGONIA CHARACTERIZATION

I. Garcia Alonso, O. S. León Fernández and *R. D. Henríques*

INSTITUTE OF CHEMISTRY AND EXPERIMENTAL BIOLOGY,
ACADEMY OF SCIENCE, CUBA

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With the use of the derivatograph it is possible to find similarities and differences between Plexauras and Plexaurellas, taking into account not only the moisture and ash content, but also the weight losses associated with the different thermal effects. On this basis thermal analysis is proposed for the rapid characterization of gorgonia.

The characterization of different biological materials by thermal analysis has been successful mainly in the study of polysaccharides and proteins. Bihari-Varga et al. [1] found that the thermal decomposition of polysaccharides at 240–300° depends on their structural characteristics, their quantitative determination being possible in this range. Protein decomposition presents two fundamental stages [2]. The first, which develops its maximum decomposition rate at 300°, is mainly due to the partial breaking of peptide linkages, while the second, in the interval 420–600°, is related with the original structure of the proteins. Nevertheless, these studies were mainly concerned with higher animal tissues, whereas we have begun to work with marine invertebrates and chiefly lobster. Good empirical correlations that allowed the quantitative analysis of ash, moisture, chitin and protein have been found [3].

Characterization of the gorgonia, and more specifically of their skeletons, is difficult, due to the complexity and insolubility of these materials [4]. Their external morphologies are in some cases quite similar, and therefore the taxonomic differentiation of the species according to chemical and biochemical characteristics is necessary, in spite of the tedious procedures of extraction and identification that are required. With regard to the advantages of thermal methods, we intend to extend the use of the derivatograph to establish the similarities and differences in the gorgonia.

Materials and methods

Samples of *Plexaura homomalla,* tipic and kukenthali forms, and *Plexaurellas grisea* and *dichotoma,* were collected at a depth of 3–4 m off the Hollywood beach in the

north part of Havana, Cuba, and stored at – 20°. The cenenquima was removed, and the skeleton was ground.

The analyses were performed in a derivatograph with a sample size of 200 mg and heating rate of 10 deg/min. The protein analysis was carried out by the Kjeldahl method [5]. The gorgonin was supplied by the Enzymology Group of our Institute.

Results and discussion

The general thermal behaviour of the studied skeletons was characterized by 3 or 4 principal effects (Figs 1 and 2). The first one appears at 90° and is connected with water elimination, which is sensibly higher in Plexauras. The second one, with DTG

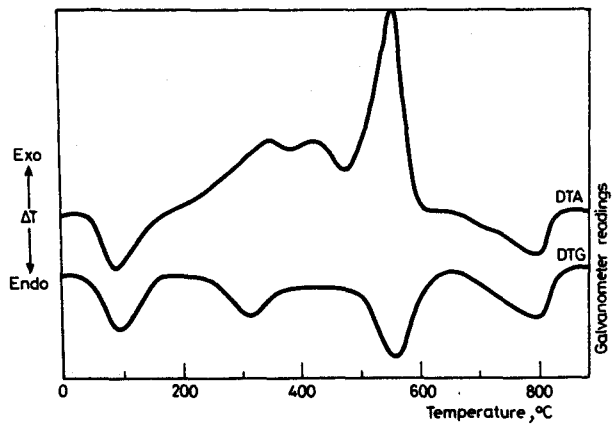

Fig. 1 Thermal decomposition of Plexaurellas

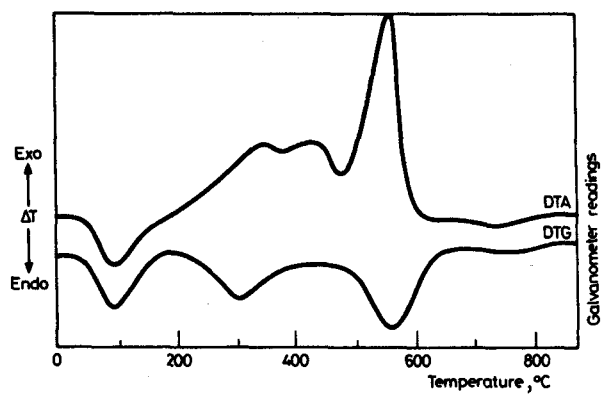

Fig. 2 Thermal decomposition of Plexauras

peak temperature at 310°, is related mainly with the decomposition of protein and polysaccharides, the lipid content of these materials being less than 1%. The existence of only one effect in this temperature range indicates the high stability of the as yet unidentified polysaccharides in these organisms.

The effect that appears between 460 and 640° is associated with the presence of protein, which is the main component in Plexauras.

The high ash content in Plexaurellas is in contrast with the relatively low proportion present in Plexauras, in which we could not observe the endothermic effect at 800° characteristic of the decomposition of Ca and Mg carbonates. Evaluation of the weight loss corresponding to the latter effect indicates that similarly as in lobster shell, the carbonates constitute 70% of the total ash of the material. Significant differences were observed between Plexauras and Plexaurellas not only in the ash content, but also in the weight losses associated with the main effects, in spite of the temperature and form of the DTA and DTG curves being essentially the same in all materials. At 320° and 560° the weight losses for Plexauras were greater than for Plexaurellas, which

Table 1 Percentage weight loss in the steps characterized by the DTG peak temperature

Sample	DTG peak, °C				Ash %
	90	320	560	800	(up to 650°C)
Plexaurella grisea	4%	10%	18%	22%	68
Plexaurella dichotoma	6%	14%	19%	21%	61

Table 2 Percentage weight loss in the steps characterized by the DTG temperature

Sample	DTG peak, °C			Ash %
	90	320	560	(up to 650°C)
Plexaura homomalla tipic form	22%	26%	36%	16
Plexaura homomalla kukenthali form	23%	23%	32%	22

Table 3 Percentage weight loss in the steps characterized by the DTG temperature after aqueous extraction

Sample	DTG peak, °C				
	320	490	560	630	780
P. grisea	8%	7%	5%	4%	22%
P. dichotoma	10%	8%	5%	2%	20%
P. H. kukenthali	14%	9%	6%	3%	–
P. H. tipic	10%	7%	11%	1%	–

corresponds to the higher protein content found in a good correlation between the protein concentration present in each variety and the weight loss at 560°, which allows a rapid estimation of the protein in each type of gorgonia (Table 4).

Table 4 Correlation between the protein concentration and the weight loss at 560°C

Sample	Protein % (x)	Weight loss at 560°C (y)
P. grisea	19	18
P. dichotoma	21	19
P. H. kukenthali	42	32
P. H. tipic	46	36

$y = 4.9 + 0.66x$, $r = 0.9979$, relative error 2%

The thermal analysis of the solid after aqueous extraction showed similar behavior in all cases, characterized by an effect at 320° and by the presence of 3 peaks in the DTG curve, at 490, 560 and 630° (Fig. 3). This type of curve suggests residue enrichment in non-soluble protein. It is known that the corals may contain antipatin and/or gorgonin, insoluble proteins resistant to the action of enzymes [6]; these are similar to keratin. These proteins constitute 60% of the total protein in the skeleton, and the DTG curve of gorgonin (shown in the figure) is quite similar to that of the residue.

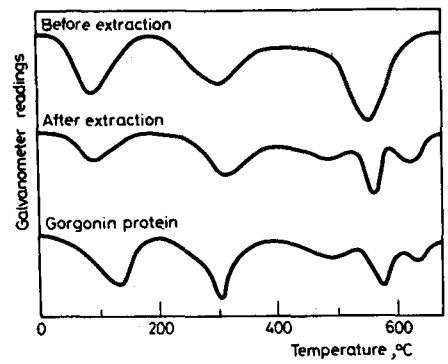

Fig. 3 DTG curves before and after soluble matter extraction of gorgonian skeletons. Comparison with gorgonin

It is important to point out that the similarities that we have found in the degradation process, before and after aqueous extraction, support the qualitative analogies found in the proteins of these materials when they were analyzed by traditional biochemical methods [7], but the derivatographic method is known to have the advantages that it is quicker, does not need initial sample preparation and does not change the basic structure of the material.

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