Comp. Biochem. Physiol. Vol. 77B, No. 4, pp. 799–801, 1984
Printed in Great Britain

0305-0491/84 $3.00 + 0.00

STUDY ON GLYCERYL ETHERS—II. α-GLYCERYL ETHER CONTENT IN TISSUES OF *OCTOPUS DOFLEINI*

S. V. Isay, O. N. Osheva and M. A. Makarchenko
Pacific Institute of Bioorganic Chemistry, Far East Science Centre, U.S.S.R. Academy of Sciences, Vladivostok 690022, U.S.S.R.

(*Received* 5 *August* 1983)

Abstract—1. The quantitative analysis of α-glyceryl ether distribution in such organs and tissues of the octopus as gill, liver, yellow body, tentacles has been carried out.

2. α-Glyceryl ethers have been shown to be present in all the above tissues, and the greatest content was shown to be characterstic of the liver.

INTRODUCTION

The lipid extracts of the octopus were shown earlier to contain considerable amounts of α-glyceryl ethers (α-GE) (Isay *et al.*, 1976). The data on the composition of α-GE and plasmalogens in the octopus are available both for separate fractions (unsaponified, phospholipids) and for organs (Karnovsky *et al.*, 1946; Thompson and Lee, 1965; Koning, 1972; Dembitsky, 1981).

In the monograph by Snyder (1972) the main attention was given to the plasmalogenic composition of organisms, and little information was given on alkyl ethers. The author explained it by the difficulty of determining the latter.

The objective of our work was to estimate the distribution of α-glyceryl ethers in the organs of a far-eastern octopus, *Octopus dofleini*.

MATERIALS AND METHODS

Tissues used

A specimen of *Octopus dofleini* was caught on the 16 April 1975 in Troits Gulf, Peter the Great Bay, Japan Sea. The following tissues were taken for the study: gills, yellow body, liver, tentacles. The lipid extracts of the above organs were prepared immediately after the octopus was caught and separated. The preparation of lipid extracts and method of quantitative analysis were as described by Isay *et al.* (1976).

RESULTS AND DISCUSSION

The data obtained are presented in Table 1. We expressed our results as a percentage relative to chimyl alcohol, believing that we did not introduce any essential error connected with the different alkyl chain lengths of glycerolipids. According to literature data from 70 to 90% or more of glyceryl ethers of various sources comprise the alkyl chains with C_{16} and C_{18} radicals (Snyder, 1972; Hallgren *et al.*, 1974; Chitwood and Krusberg, 1981: Satouchi *et al.*, 1981).

Our data indicate α-GE to be present in all the organs, and the order of α-GE content is practically the same in all the tissues except the yellow body. However, it should be noted that the highest content of the α-GE, as in case with some species of sharks, is characteristic of the octopus liver rather than the other tissues. Practically all the GE fraction isolated from the liver is represented by α-GE, while the share of all the other isomers is only 3%.

Thompson and Lee (1965) found that phospholipids from the pancreatic gland of *O. dofleini* contained about 6.5% of α-GE. There also exists the discrepancy between the data of this work and our results concerning the tentacle analysis: the authors found a very low total lipid composition, while according to our data the total lipid content in this tissue was several times (more than six times) higher. This difference can be attributed to the seasonal variations in fat accumulation but Thompson and Lee unfortunately did not indicate the time of year when the organism was collected.

There is extensive literature on the GE determination in liver of both the lower and the higher types of organisms, including marine organisms. It may be connected with the role of this organ. Liver

Table 1. Comparative evaluation of contents of lipids, unsaponifiable fraction and α-GE in organs and tissues of *Octopus dolfleini*

Tissue	Total lipids (%)	Unsaponifiable fraction (%)	α-GE content relative to total lipids (%)	α-GE content relative to GE sum (%)
Gill	1.30	14.12	1.45	74.5
Yellow body	1.54	70.98	0.49	50.0
Liver	6.56	40.85	1.95	97.0
Tentacles	2.64	57.04	1.75	50.4
Total	12.04		5.65	

is the main organ in which the lipids are stored (Craik, 1978), metabolism takes place there very quickly and the rate of phospholipid synthesis is very high (Lucas and Ridout, 1967). It has been shown that in some diseases GE accumulation in some organs, including liver, takes place (Lin *et al.*, 1976; Owen *et al.*, 1981). With connection to this, Lin *et al.* (1980) suggested using GE as markers for tumours, both in man and animals, during the precancer state.

The data on the content of liver GE in man and animals are contradictory. According to one source, in one and the same object (rat liver) the GE level is low, and according to another is higher than in other organs (Snyder, 1972; Curstedt, 1977; Lee *et al.*, 1980). However, the main trend is that the healthy liver contains small quantities of GE and plasmalogens. The same discrepancy is also characteristic of the liver of various species of sharks. For the first time, GE in substantial quantities were isolated from the liver oil of three species of sharks (*Chimaerida*, *Batoidei* and *Selachii*) and their trivial names were derived from the names of the animals from which they were isolated (chimyl, batyl and selachyl alcohols). In 1971 Kayama *et al.*, having analysed six other species of sharks, showed the GE content in liver oils of various species of sharks to be very variable (0.4–11%). Simultaneously, Spener and Mangold (1971) confirmed the substantial variability of the GE content in shark liver (3–40%). Craik (1978) showed that in only one of the six analysed shark species was the GE amount the highest (in liver oil lipids). Analysis of the GE distribution in various tissues of sharks has shown that their greatest content is in the liver (Sargent *et al.*, 1973; Craik, 1978), which distinguishes them from terrestrial organisms.

Along with the traditional GE, 2-oxyderivative GE were isolated from the liver of the Greenland shark (Hallgren and Ställberg, 1974) and 2-methoxyderivative GE from marine organisms as well (Hallgren *et al.*, 1974). There is an opinion that the GE are more widespread and occur in marine animals more often than in terrestrial animals (Hallgren and Larsson, 1962; Mori *et al.*, 1972; Hallgren *et al.*, 1974; Totani and Mangold, 1981) and as a rule, the major amount of GE is concentrated in the liver.

Kapoulas and Ermidou (1976) have shown that in the amphibian salamander GE are also represented in liver to a greater extent than in other organs and tissues.

The Japanese authors showed that liver oil of edible crabs contained not only a considerable amount of α-GE (19.7–69.0% in the unsaponifiable fraction) but a wide variety as well from C_8 to C_{19} alkyl components (Hayime *et al.*, 1971; Kazuo *et al.*, 1973).

Along with the GE and the plasmalogens, the fatty acid composition of various species of the octopus is being studied. Koning (1972) showed that the occurrence of ceramidaminoethylphosphonic acid is a characteristic feature of octopus phospholipids. Among the fatty acids the greater part are such polyunsaturated fatty acids (PUFA) as $C_{20:4}$, $C_{20:5}$, $C_{22:4}$, $C_{22:5}$ and $C_{22:6}$. Especially great a content is noted for $C_{22:6}$ acid (23% of the total fatty acid methyl esters).

The study (Busarova and Isay, 1982) on the determination of fatty acid composition in organs of one of the species of far-eastern octopus (*Octopus conispadiceus*) showed agreement in both the PUFA set and their quantitative proportionality with Koning (1972). However, it should be noted that the studied species were different, and the areas of their collection were also different. According to our data the greatest content of $C_{22:6}$ acid was characteristic of gonads (0.4% per wet tissue weight). As for the liver of *O. conispadiceus*, $C_{18:1}$, $C_{20:5}$ and $C_{22:6}$ acids were characteristic, their contents being 0.48, 0.48 and 0.17% respectively.

It may be suggested that a docosahexaenoic acid is characteristic of the reproductive organs. Ramachandran and Gopokumar (1981) showed that the content of $C_{22:6}$ acid in fish ovule (9.09%) was considerably higher than in the total lipid fraction of the body and intestine. $C_{22:6n3}$ acid was converted into prostaglandin $F_{4\alpha}$ (Mai *et al.*, 1981).

Octopus is a commercial animal. In Japan, for example, it is not only caught but is also cultivated on a commercial scale. Only the mantle is taken for food, all the other organs being waste products, and thus can become a source of not only α-GE, but such valuable preparations as PUFA and, primarily, $C_{22:6}$ acid as well.

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