26. C. I. Lauter and E. G. Trams, J. Lipid Res., 3, 136 (1962).
27. Yu. L. Zherebin and A. A. Kolesnik, Khim. Prir. Soedin., No. 3, 296 (1984).
28. E. L. Kean, J. Lipid Res., 7, 449 (1966).
29. H. Wagner, L. Hoerhammer, and D. Dengler, J. Chromatogr. 7, 211 (1962).
30. T. G. Zhmyrko, N. P. Goncharova, É. I. Gigienova, and A. I. Glushenkova, Khim. Prir. Soedin., 300 (1984).
31. A. Ya. Boyarskii, Statistical Methods in Experimental Medical Studies [in Russian], Meditsina, Moscow (1972).
32. A. N. Zaidel', Elementary Estimates of Measurement Errors [in Russian], Nauka, Leningrad (1967).

SYNERGISM OF PHOSPHOLIPIDS IN EXTRACTS OF MARINE INVERTEBRATES

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The qualitative and quantitative compositions of the phospholipids of prostaglandin extracts of 18 species of marine invertebrates have been determined. A correlation has been shown between the set of phospholipids in the extract and prostaglandin-like activity. For samples with a high prostaglandin-like activity in the set of phospholipids the presence of either diphosphatidylglycerol, phosphatidyl glycerol, phosphatidylethanolamine or a combination of these lipids is necessary.

We have shown previously [1] that the phospholipids (PhLs) in prostaglandin extracts have a pronounced effect on the activity of these extracts and have given a quantitative estimate of the contribution of concrete PhLs to this activity. Investigations on the synergism of PhLs relative to prostaglandins (PGs) have shown the existence of a correlation of the set of PhLs in the extract and its PG-like activity. In the present work we have continued an investigation of this phenomenon and have expanded the range of specimens investigated and the area of their habitats.

The multistage extraction procedure that we use [2] permits the most complete extraction of the PGs from tissue. However, together with the PGs, various substances of lipid nature pass into the extract including PhLs which, obviously, are present in a complex with the PGs [3-7]. We have shown previously for the case of the well-studied coral Plexaura homomalla that the PG activity of the extract from this organism depends substantially on the concrete PhLs present in the extract [1]. Here thegreatest synergism is shown by the PhGs.

In the present paper we give the comparative characteristics of the PhLs present in PG extracts from marine invertebrates. The results are shown in Table 1, where figures are presented for the PGs of group B, which is formed as the result of the alkaline treatment of the PGs of groups E and A and also as the result of the storage of the samples and their preparation for analysis, i.e., it is not originally present in the extract [8]. It is known that the PGs of group A do not cause contraction of the smooth musculature of the rat uterus and, accordingly, are not an active form for the biotest that we use.

Two soft corals were distinguished by the lowest amount of PGs in the tissue: Alcyonidae sp. and Plexaura homomalla. The first was inactive, and from the amount in the form of PG inactive in this biotest [(PGB (μg/g of tissue)] it several times exceeded the other specimen. The second was extremely active. This showed that the PGs present in this extract belonged to groups E and F, which are capable of causing the contraction of the smooth musculature of the uterus. The two soft corals differed from one another also by the PhLs that they contained. Of the four representatives of the coelenterate type, the two inactive sam-

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TABLE 1. Amounts of PhLs and PGs in Extracts from Tropical Invertebrates

Type, class, species	Activity	PhL, % on the PG extract									PG extract, % on the tissue	PGB, μg/g of tissue
		DPhG	PhG	PhE	LPhE	PhS	PhC	LPhC	SM	PhI		
Coelenterata												
1. Stoichactis sp.	—	—	—	27 5	Tr.	46.3	—	—	12,5	Tr.	0.03	2 5
2. Alcyonidae sp.	—	—	—	3.8	1,3	—	18.9	—	1.3	—	3.70	258.5
3. Sarcophyton sp.	+	2.5	—	10.2	6.2	—	5.1	—	11.0	Tr.	1.30	15.0
4. Plexaura homomalla kuklentaiy	+	—	4.1	16.2	—	1c.1	—	—	—	13.0	2.00	1.00
Gastropod mollusks												
5 Acanthopleura gemmata, lipid extract	—	—	—	7.5	Tr.	—	—	—	1.5	22.4	0.14	5.5
5. Acanthopleura gemmata, PG extract	+	19.2	0.8	16.3	9.6	—	—	—	14.4	14.5	0.18	7.5
6. Charonia tritonis	—	—	—	Tr.	—	—	21.6	21.5	22.8	Tr.	0.30	0.2
7. Conus textili	+	—	1 0	10.3	—	—	5.0	10.0	2.5	—	0.70	12,0
8. Conus vexillus	—	—	4.8	1.2	5.0	5.0	—	—	—	Tr.	0.30	15,3
9. Lambis lambis	+	—	—	22.0	7.1	—	2.2	—	18 9	—	0,19	55,6
10. Lambis truncata	—	—	—	—	—	—	6.5	Tr.	13.0	10.0	0,17	14,0
11. Strombus luhuanus	—	—	—	Tr.	Tr.	—	—	—	34.0	Tr.	0,20	56.5
12. Trochus niloticus	+	—	—	0.6	5.4	5.4	6.8	—	30.4	—	0,26	80,0
Bivalves												
13. Big Oyster	—	—	—	1.9	—	11.6	—	—	42.3	Tr.	0,10	9.8
14. Hippopus hippopus	—	—	—	4.3	10.4	4.3	—	—	12.8	—	0,28	40.0
15. Tridacna squamosa	—	Tr.	Tr.	Tr.	—	—	Tr.	—	6.8	—	0.55	18.0
16. Pteria sp	+	—	—	25.4	21.1	19.6	12.7	—	19.6	—	0,15	50.0
17. *Tridacna maxima*	+	—	—	18.4	Tr.	—	—	—	—	5.9	0,30	3.9
18. Holoturia edulis	+	21.8	—	—	—	Tr.	—	—	—	14.4	0,20	24.4

Note. DPhG) diphosphatidylglycerol; PhG) phosphatidylglycerol; PhE) phosphatidylethanolamine; LPhE) lysophosphatidylethanolamine; PhS) phosphatidylserine; PhC) phosphatidylcholine; LPhC) lysophosphatidylcholine; SM sphingomyelin; phI) phosphatidylinositol.

ples were inferior with respect to the quantitative composition of the PhLs to the two active samples, in one of which DPhG was detected, this being found only in specimens with a high PG-like activity, while in the other PhG was found, which is also present predominantly in active samples.

For the sample of Acanthopleura gemmata (gastropod) we obtained two types of extracts – lipid and PG extracts. This made it possible to compare them with respect to the levels of PhLs and the presence of PG-like activity. The results that we obtained for the PhL compositions of the two types of extracts confirmed literature statements that PhLs are extracted more completely with the use of ethanol [9]. This experiment showed that PG was present to practically equal degrees in the lipid and the PG extracts. But, at the same time, the PhL compositions of the extracts differed greatly in amount and quality. In the PG extracts we had a set of PhLs making a substantial contribution to the activity of the extract [1], while in the lipid extract these PhLs were absent.

The investigation that we have performed shows that in nature there exists a natural synergism of PhLs with PGs. We have found that synergism is exerted by many PhLs in different degrees. Apparently the absence of one PhL is compensated by some other PhLs and possibly by a set of them.

EXPERIMENTAL

Eighteen species of invertebrates were collected in the period from January to March, 1980, in a marine expedition on the Scientific Research Ship Professor Bogorov in various geographical zones: in the region of the Great Barrier Reef, Australia, the Singapore reefs, and in Western Samoa. The organisms were of three types: coelenterates, mollusks (gastropods, bivalves), and echinoderms. The preparation of the PG and lipid extracts, the determination of their PG-like activities, and the qualitative and quantitative analysis of the PhLs were carried out as described in [1].

LITERATURE CITED

1. E. M. Katrich, S. V. Isai, and T. Ya. Mishchenko, Khim. Prir. Soedin., No. 3, 322 (1990).
2. O. D. Korotchenko, T. Ya. Mishchenko, and S. V. Isay (Isai), Comp. Biochem. Physiol., 74C, No. 1, 85 (1983).
3. Y. Mizushima, A. Yanagawa, and K. Hoshi, J. Pharm. Pharmacol., 35, No. 10, 666 (1983).
4. M. R. Belova, T. K. Ustynyuk, L. M. Bragintseva, and G. A. Osipov, Pharmatsiya, No. 5, 25 (1984).
5. D. V. McGivern and G. S. Basran, Eur. J. Pharmacol., 102, 183 (1984).
6. Y. Mizushima, Y. Shoshi, T. Kato, M. Fukushima, and S. Kurozumi, J. Pharm. Pharmacol., 38, No. 2, 132 (1986).
7. Y. Mizushima, Y. Shiokawa, M. Homma, S. Kashiwazaki, Y. Thikawa, H. Hashimoto, and A. Sakuma, J. Rheumatol., 14, No. 1, 97 (1987).
8. N. H. Andersen, J. Lipid Res., 10, 320 (1969).
9. É. V. Dyatlovitskaya, G. I. Gorkhovskaya, and L. D. Bergel'son, Biokhimiya, No. 34, 177 (1969).