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FATTY ACIDS IN THE BLUBBER OF THE MEDITERRANEAN MONK SEAL, Monachus monachus (Hermann, 1779)

AKDENİZ FOKU , *Monachus monachus* (Hermann, 1779) *YAĞINDA BULUNAN YAĞ ASİDLERİ*

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Abstract

In this study Mediterranean monk seal, *Monachus monachus* oil has been examined for the first time.using capillary gas chromatography twenty-two fatty acids(FAs) were identified from monk seal oil. Oleic (18:1n-9, 24.7 %), palmitoleic (16:1n-7, 23 %), palmitic (16:0, 20.8 %), miristic (14:0, 6.2 %), cis-vacsenic (18:1n-7, 5.7 %), docosahexaenoic (22: 6n-3, 4.7 %) and erusic (22:1n-7, 3.1 %),eicosapentaenoic (20:5n-3, 1.3 %) and docosapentaenoic (22:5n-3, 1.2 %) acids were prominent. Combained amount of the unsaturated FAs were 133 % higher then saturated. The blubber oil of the Mediterranean monk seal contained considerably less 20:5n-3, and 22:6n-3 than the blubbers of ringed seals (*Phoca hispida*) from the Baltık Sea, Spitsbergen, Lake Ladoga and Lake Saimaa. The differences among the FAs in these species could be due to different dietary factors and species.

Introduction

Mediterranean monk seal, *Monachus monachus* (Hermann, 1779) is one of the endangered mammal species on world. The Mediterranan population of *Monachus monachus* is estimated between 100-150 individuals, with greatest concentration in the Eastern Mediterranean, particularly in the Aegean coast of Turkey and Greece (Caltagirone,1995). Competition with fishermen, human disturbance, loss of habitats, pollution, and overfishing, all threaten the survival of the species.

Declining fish stocks make the monk seal a competitor and enemy of fisherman mostly in the Aegean archipelagos. At the same time, monk seals has become dependent on the fisherman for food and seek out fishing boat, stealing fish and damaging nets. This has been aggravated by the increased exploitation by now of the Mediterranean coast in the last 50 years. As a result of competition, seals are sometime clubbed or shot by fisherman and are also occasionally caught in modern fishing gear and drowned.

Turkish coastline is one of the breeding and reproduction sites of the monk seal and animal lives in four main zones. Recent estimation of the whole population is less than 50 individuals in Turkish waters and there were six monk seals which were caught accidentally by gill nets between 1987 and 1991 in the Turkish coastal waters (Öztürk *et al.*, 1991, 1994).

The properties of marine organism oils are fluid at low temperature,high degree of unsaturation and high content of non-saponifiable materials and the present of unusual lipid classes as wax esters, alkyl diachylglycerols and hydrocarbons. The lipids are particularly important for marine organisms as many neutral lipids are significantly less dense than water. Consequently, these lipids generate buoyancy and help most of marine mammals to reach an essentially weightless condition that is of immense advantage in a living space that lacks solid supporting surfaces. The role of lipids in providing metabolic water may also be of greater importance in marine animals than in their terrestrial counter part since the former are continually being desiccated in hyper-osmotic environment.

Fatty acid compositions of marine oils vary in different species and also show some variation in same species according to the environmental and dietary factors. Marine oils contain high level unsaturated fatty acid and they are characterized by increased proportions of higher n-3 fatty acid, 20:5, 22:5 and 22:6. Monounsaturated fatty acids, 16:1n-7, 18:1n-9, 20:1n-9 and 22:1n-9 are prominent in marine oils (Ackman,1967; Malins *et al.*,1970; Menzell *et al.*,1964; Sargent ,1976).

Although several papers have been published on the lipids of fish,as far as we know the lipids of Mediterranean monk seal have not been studied. In this investigation one of the adult monk seal's blubber oil was analysed which is accidentally killed at the gill net.

Materials and Methods

The blubber oil was obtained from the male animal which was drowned in gill nets in the Foça region in June 1992. This male monk seal has dissected and taken blubber part for separating to oil analysis. Fatty acids analysed by using Perkin Elmer 8420 Capillary Gas Chromatograph, Gouda, The Netherland.

Fatty acid profile of monk seal oil was prepared by using a method based on the classical lipid extraction method of Folch et al., modified by Yazıcı et al., 1992,1994. Monk seal oil was weighted, and 0.1 ml internal standard (200ug heptadecanoic acid in chloroform), 0.1ml of methanol containing 20g/L butylated hydroxytoluene, as antioxydant, 1ml 154 mM NaCl, 2ml methanol and 4 ml chloroform were added and the sample vortex-mixed for 2 min. After centrifuging (2,000g; 10 min; 4^{o}C) the chloroform phase was removed and evaporated to dryness at 37^{o}C under a stream of nitrogen. The total lipid extract was dissolved in 8 ml of methanol/KOH (98:2 v/w) and saponified by heating in a boiling water bath for 5 min. After cooling for 2-3 min, 1 ml 14 % BF_3-methanol reagent was added to methylate the fatty acids. The sample heated for 2 min at 100^{o}C and cooled for 2-3 min. 5 ml distilled water and 2 ml hexane added, the sample vortex-mixed for 2 min

and centrifuged (2,000g; 10 min; 4°C). The upper organic phase was evaporated to dryness under a stream of nitrogen and redissolved in hexane prior to GC injection.

The fatty acid methyl esters were analysed by capillary gas chromatography (column:50x0.25mm WCOT fused Silica, CP-Sil 88; flame ionisation detector temperature 300°C; carrier gas N_2 ; splitter injector temperature 290° C; oven temperature programme from 150 to 240° C at 2° C min^{-1}).

Fatty acid standards mixture contained the following fatty acid methyl esters, were used to determine the total fatty acid profiles: Lauric, 12:0; myristic, 14:0; palmitic, 16:0; palmitoleic, 16:1; stearic, 18:0; oleic, 18:1; cis-vaccenic, 18:1; cis-linoleic, 18:2; linolenic, 18:3; 6,9,12,15-octadecatetraenoic, 18:4; arachidic, 20:0; cis-11-eicosanoic, 20:1; 11,14-eicosadienoic, 20:2; cis-11,14,17-eicosatrienoic, 20:3; arachidonic, 20:4; 5,8,11,14,17-eicosapentaenoic, 20:5; behenic, 22:0; erusic, 22:1; cis-13,16-docosadienoic, 22:2; 7,10,13,16-docosatetraenoic, 22:4; 7,10,13,16,19-docosapentaenoic, 22:5; cis-4,7,10,13,16,19-docosahexaenoic,22:6; lignoceric, 24:0 and nervonic, 24:1.

Results and Discussion

The analitical data of monk seal oil and comparison of those in different marine oils are shown in Table 1. Fish oils have generally high iodine value because of their high unsaturated FA content. Acid value, indication of free FA level, is taken as one of essential items for specifying the quality of fish oil.

Twenty-two FAs were identified from monk seal oil (Fig. 1). Relative contribution of FAs, combined amounts of n-3, n-6, n-7, n-9, saturated and unsaturated FAs, and the ratios of some FAs are shown in Table 2 and Table 3.

The major FAs were oleic, palmitoleic and palmitic in monk seal oil. Unsaturated FAs, contained about 83 % monounsaturated FAs and 17 % polyunsaturated FAs, were 133 % higher than saturated FAsMediterranean monk seal had high proportions of saturated FAs and low unsaturated FAs compared to herring and cod from Atlantic, and n-3 FAs were particulary low in monk seal (Table 3). As anticipated, the blubber of monk seal contained less 20: 4n-6 then the fresh water seals. But the proportions of 20:5 n-3, 22: 5n-3 and 22: 6n-3 in the monk seal blubber were also less then those of the ring seals from Baltic Sea and Spitsbergen (Table 4). These differences seem to be due to metabolic divergence and different dietary factors. The polyunsaturated FAs of the seal blubbers cuold be produced by and oxidation, delta-5- desaturase, delta -6-desaturase and elongase. However, it is known that the FA composition of seal blubber reflects the dietary FAs to a great extent. Especially, the freswater and marine seals have very different compositions, the former having more of the n-6 FAs that are abundant in freshwater fish (Achman,1967; Kakela *et al.*, 1995).

Table 1. Comparison of analytical values in monk seal and different marine oils.

Sort	Iodine value	Refractive index	Acid value	Solid content	Peroxide value
Monk seal	107.7	1.467	7.3	3.6	20.7
Sperm whale	100	1.450	3		
Fin whale	130	1.470	5		
Commen dophin	133	1.479	13		
Fur seal	140	1.475	2		

Table 2. Fatty acid composition of monk seal oil Figures expressed as percentage of total fatty acids.

Fatty acid	
Lauric 12:0	0.2
Myristic 14:0	6.2
Palmitic 16:0	20.8
Palmitoleic 16:1n-7	23.0
Stearic 18:0	2.8
Oleic 18:1n-9	24.7
Cis-vaccenic 18:1n-7	5.7
Linoleic 18:2n-6	2.4
Linolenic 18:3n-3	0.2
Octadecatetraenoic 18:4n-3	0.3
Arachidic 20:0	0.1
Cis-11-eicosanoic 20:1n-9	1.7
Eicosadienoic 20:2n-6	0.5
Eicosatrienoic 20:3n-3	0.1
Arachidonic 20:4n-6	0.4
Eicosapentaenoic 20:5n-3	1.3
Behenic 22:0	0.04
Erusic 22:1n-7	3.1
Docosadienoic 22:2n-6	0.04
Docosatetraenoic 22:4n-6	0.5
Docosapentaenoic 22:5n-3	1.2
Docosahexaenoic 22:6n-3	4.7

Table 3. Comparison of the ratios and combined amount of some fatty acids in monk seal and two different marine oils.

	Monk seal	Atlantic herring*	Atlantic cod
n-3	7.8	12.7	27.6
n-6	3.8	1.6	3.0
n-7	31.8	31.8	15.5
n-9	26.4	28.7	30.2
Saturated	30.1	17.2	18.6
Unsaturated	69.9	74.7	76.7
Monounsaturated	58.3	60.9	45.8
Polyunsaturated	11.6	14.3	30.6
n-3/n-6	2.05	7.50	9.2
Saturated/Unsaturated	0.43	0.23	0.24
16:0/16:1	0.90	0.91	1.35
18:0/18:1	0.11	0.10	0.10
18:2/20:4	0.77	1.75	1.07

* From Sargent, 1976

Table 4. Comparison of the very long chain polyunsaturated FAs in the blubbers of the monk seal from Mediterranean, the ringed seals from Lake Saimaa, Lake Ladoga, The Baltic Sea and Spitsbergen.

	Marine			Freshwater	
Fatty acid	*Monacus monacus*	*P.hispida* botnica*	*P.hispida* hispida*	*P. hispida* saimensis*	*P. hispida* ladogensis*
20 : 3n-3	0.1	0.35	0.11	0.41	0.61
20: 4n-6	0.4	0.8	0.4	3.5	1.8
20: 5n-3	1.3	8.1	8.9	6.4	7.5
22: 4n-3	0.5	0.5	0.1	0.2	0.3
22: 5n-3	1.2	5.8	6.6	6.8	6.3
22: 6n-3	4.7	14.0	13.7	9.8	12.3

*From Kaela *et al.*, 1995.

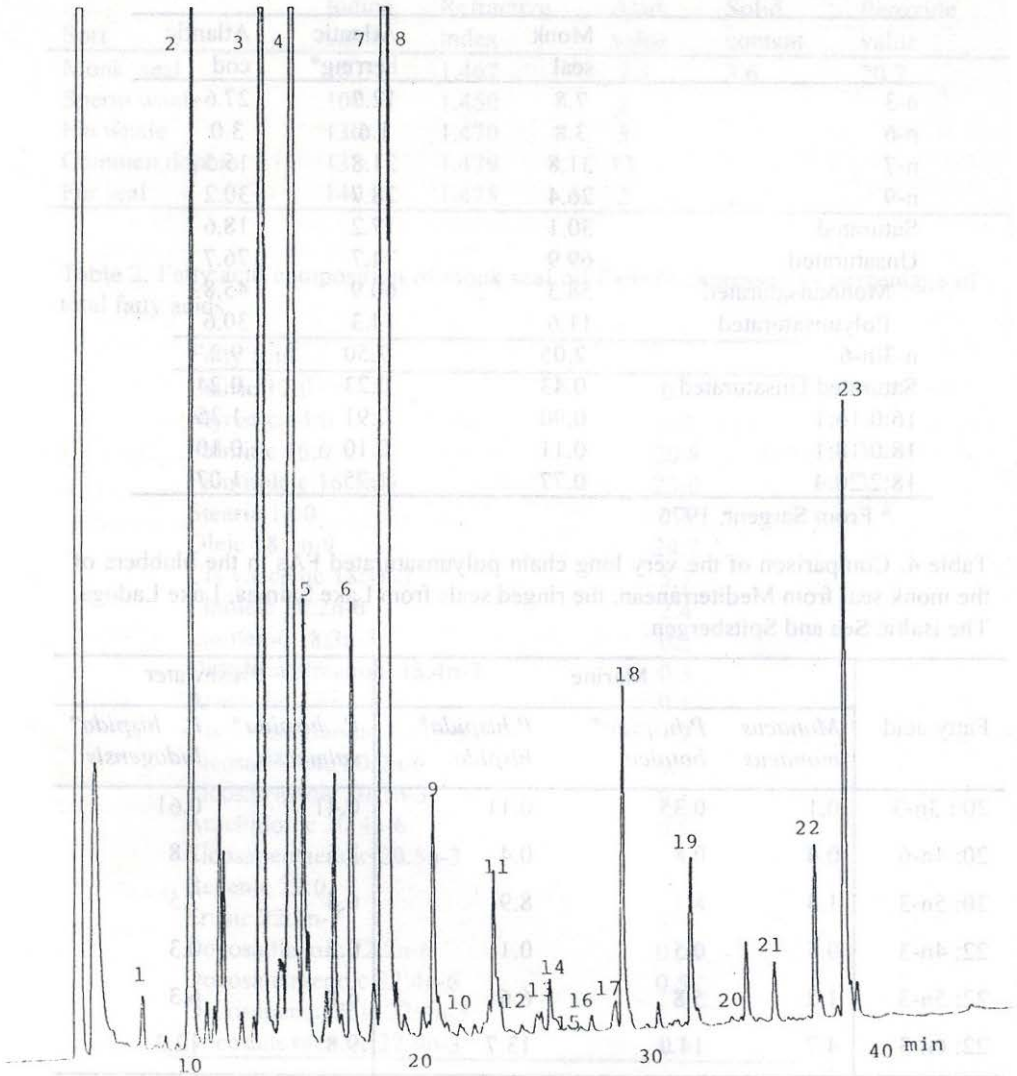

Fig 1. Chromatogram of fatty acid profile from monk seal oil. The numbered peaks refer to the following fatty acids: 1 lauric, 2 myristic, 3 palmitic, 4 palmitoleic, 5 internal standard, 6 stearic, 7 oleic, 8 cis-vaccenic, 9 linoleic, 10 arachidic, 11 cis-11 eicosanoic, 12 linolenic, 13 octadecatetraenoic, 14 eicosadienoic, 15 behenic, 16 eicosatrienoic, 17 arachidonic, 18 erusic, 19 eicosapentaenoic, 20 docosadienoic, 21 docosatetraenoic, 22 docosapentaenoic, 23 docosahexaenoic.

Özet

Bu çalışmada ilk kez Akdeniz Foku, *Monachus monachus* yağı incelendi. Yağın kapiller gaz kromotografında yapılan analizinde 22 yağ asiti saptandı. Elde edilen sonuçlara göre fok yağı büyük oranda sırasıyla Oleik (18:1n-9, % 24.7), palmitoleik (16:1n-7, % 23), palmitik (16.0, % 20.8), miristik (14:0, % 6.2), vis-vaksenik (18:1n-7, % 5.7), dokosahekzaenoik (22:6n-3, % 4.7), erusik (22:1n-7, % 3.1), eikosapentaenoik (20: 5n-3, % 1.3) ve dokosapentaenoik (22: 5n-3, % 1.2) asitleri bulunmaktadır. Doymamaış yağ asitleri % 133 oranında doymuş yağ asitlerinden fazladır.Baltık denizi, Lagoda gölü ve Saimaa gölünde yaşayan *Phoca hispida* türü foklarla karşılaştırıldığında, *Monachus monachus* yağı daha az oranda 20:5n-3, 22:5n-3 ve 22:6n-3 içermektedir.

References

Ackman, R.G., (1967). *Comparative Biochemistry. Physiol.* 22:907.

Anonim. (1974). Fisheries Chemistry. Overseas Technical Cooperation Agency. Japan.

Kakela,R.,Ackman R.G., Hyvarien , H. (1995). Very long chain polyunsaturated fatty acids in the blubber of ringed seals (Phoca hispida) from lake Saimaa ,Lake ladoga , The Baltık Sea, and Spitssbergen. *Lipids*, 60: 725-734.

Caltagirone ,A ,. (1995). The Mediterranean Monk Seal. UNEP.Mediterranean Action Plan ,Reginonal Activity Center for Specially Protected Areas .Tunusia

Malins, D.S., Wekell, J.C., Houle, C.R., (1970): *Journal of Lipid Research*, 6:100.

Menzell, D.B., Olcolt, H.S., (1964: *Biochemistry Biophysics Acta*, 84:1333.

Öztürk, B., Candan, A., Erk, H., (1991). Cruise results covering the period from 1986 to 1991 on the Mediterranean monk seal occurig along the Turkish coast line council of Europe Concervation of the Mediterranean monk seal. Technical and Scientific Aspects. No:13 Council of Europe Press, Antalya, Turkey.

Öztürk, B., (1992). Akdeniz Foku, Monachus monachus. Book (in Turkish)), pp 215, Anahtar Publ., Istanbul, Turkey.

Sargent, J.R., (1976). The structure, metabolism and function of lipids in marine organisms.In Biochemical and Biophysical Perspective in Marine Biology (Eds:Malins, D.C., Sargents, J.R.) .Academic Press, London ,pp 149-212.

Yazıcı Z., Taveres, I.A., Stamford, P.I., Bishai, P.M., and Bennetts, A., (1992). Changes in tissue fatty acid composition in murine malignancy and following anticancer therapy. *Br. J. Cancer*, 65:163-170.

12. Yazıcı Z., Sener A., Malaisse W.J. (1994). Pancreatic islet and parotid cell fatty acid composition. *Med. Sci. Res.*, 22:377-378.

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