Fishery Technology
1995, Vol. 32 (1) pp : 50 - 52

Fatty Acid and Mineral Composition of Papua New Guinea Echinoderms

H.Maven, K. Sunder Rao*, W. Benko+, K. Alam, M.E. Huber, T. Rali and I. Burrows
Department of Chemistry and Biology, University of Papua New Guinea, P.O. Box 320, University P.O., N.C.D. Papua New Guinea

+ *National Analysis Laboratory, The Papua New Guinea University of Technology, Private Mail bag, Lae Morobe Province, Papua New Guinea.*

The fatty acid composition of three *Holothuria* spp. and one *Bohadschia* sp. were determined by gas liquid chromatography. Arachidonic acid (20:4n-5) was the predominant fatty acid (25.29-34.49%) in the three *Holothuria* spp. while eicosatrienoic (20:3n-6) was predominant in the *Bohadschia* sp. Docosahexaenoic acid (22:6n-3) and eicosapentaenoic acid (20:5n-3) concentrations were appreciable. The mineral (Na, K, Ca, Mg, Fe, Zn, Cu, Cd, Pb, Hg, As, Se) composition of the echinoderms were determined by Atomic Absorption Spectrophotometry. The alkali (Na and K) and alkaline (Ca and Mg) metals were abundant in the tissue while the heavy metals (Cu, Cd, Pb, Hg) and metalloids (As and Se) were minor constituents.

Key words : Echinoderms, fatty acid composition, mineral composition, *Holothuria edulis, H. impetius, H. fascopundata, Bohadschia marmorata*, Papua New Guinea.

Some echinoderms are consumed by the coastal people of Papua New Guinea as a source of protein. The fatty acid distribution of Atlantic sea urchin *Strongylocentrotus droebachiensis* (Takagi *et al.*, 1980) and twelve species of *Echinoidea* (Takagi *et al.*, 1986) have been reported. Essential fatty acids such as docosahexaenoic acid and eicosapentaenoic acid have an inhibitory role on platelet aggregation which prevent the risk of thrombosis (Dyerberg, 1982; Kinsella, 1986; Ackman, 1988). Information is not available on the nutrients in echinoderms of Papua New Guinea. This study was focused on determination of the fatty acid and mineral composition and will provide valuable nutritional information on the echinoderms of Papua New Guinea.

Materials and Methods

The specimens were collected by scuba diving from the coast of Port Moresby, Papua New Guinea. About 20 g of the flesh was extracted for total lipid according to Folch *et al.* (1957). The lipids were determined gravimetrically after the removal of the solvent from the lipid extract under reduced pressure and temperature (40°C) using a rotary evaporator. The total lipids were transesterified with 7% BF_3-CH_3OH to methyl esters according to the procedure described by Napolitano *et al.* (1988) and analysed on a Varian model VISTA 6000 gas liquid chromatograph equipped with a flame ionization detector (FID) and a Supelcowax-10 flexible fused silica capillary column (30 m x 0.25 mm i.d., Supelco Inc., Bellafonte, PA, USA). Helium was used as a carrier gas. The oven temperature was programmed from 185 to 235°C at 3°C min^{-1} after an initial hold of 8 min and with a final hold of 10 min at 235°C. The injector and detector temperatures were maintained at 250 and 270°C,

* Corresponding author.

respectively. Peak areas were converted to weight % fatty acids by correcting the FID response using a computer program developed by Ackman & Eaton (1978). The tissues (0.2 g, dry weight) were digested for elemental analysis with 3 ml nitric acid in pressurised teflon bombs (Parr Instrument Company, Moline, IL, USA) using a Philips commercial microwave oven (800 w). The samples were heated at high setting for 2 min at 1 min intervals and cooled to room temperature. The digest was left at room temperature for 30 min after a dropwise addition of hydrogen peroxide till fizzing ceased. The solutions were then quantitatively transferred to volumetric flasks. Flame atomization atomic absorption spectrophotometry (Varian model Spectr AA20) was used for the quantification of Zn, Fe, Ca, Na, K and Mg, while graphite furnace atomic absorption spectrophotometry (Varian model Spectr AA 30/40) was used for Cu, Pb and Cd. Aqueous standards were used against each metal after some trial runs using the standard addition technique produced the same results. Concentration of mercury in the digest samples were determined using the cold vapour technique with stannous chloride as the reductant, while arsenic and selenium were determined using a Perkin-Elmer 3100 atomic absorption spectrometer equipped with FIAS-200 flow injection technique.

Results and Discussion

The total lipids varied between 0.55% (*Bohadschia marmorata*) and 1.84% (*Holothuria impetius*) on wet basis. The total lipid content of the three *Holothuria* spp. were higher than *B. marmorata*.

The fatty acid composition is shown in Table 1. The major fatty acid groups were saturates, tetraenes, monoenes and trienes. The major saturated fatty acid was palmitic acid (11.68-18.28%) followed by stearic acid

Table 1. Fatty acid composition.

	Holothuria edulis	*Holothuria impetius*	*Holothuria fascopundata*	*Bohadschia marmorata*
Lipids (%)	1.44	1.84	1.07	0.55
Fatty acids (wt %)				
12:0	0.02	0.02	0.01	0.10
13:0	0.34	0.32	0.53	0.63
14:0	0.89	ND	0.67	0.67
15:0	0.51	0.51	0.96	1.16
ISO 16:0	0.59	0.69	0.36	0.40
ANT 16:0	0.72	0.55	0.18	0.39
7Me 16:0	1.58	0.75	1.17	0.63
16:0	11.68	13.49	18.28	13.78
17:0	0.69	0.31	0.02	0.89
18:0	6.09	8.89	7.20	8.20
20:0	0.03	0.53	1.31	1.59
22:0	2.05	3.74	1.32	2.18
Saturates	25.19	29.80	32.01	30.65
16:1n-7	3.48	4.25	10.05	5.89
16:1n-5	0.85	0.50	0.51	ND
18:1n-9	1.59	6.81	1.98	2.00
18:1n-7	1.17	ND	1.06	2.42
18:1n-5	0.11	0.09	0.06	0.16
20:1n-11	7.98	5.94	4.31	7.10
20:1n-9	0.48	ND	0.39	0.78
20:1n-7	0.23	ND	0.37	ND
Monoenes	15.89	17.59	18.73	18.35
16:2n-6	1.74	0.25	0.73	0.29
16:2n-4	0.72	0.48	0.34	0.74
18:2n-6	0.31	1.90	0.72	0.67
18:2n-4	0.13	0.24	0.29	0.37
20:2NMID	0.99	0.58	0.24	0.95
Dienes	3.89	3.45	2.32	3.02
16:3n-4	0.03	ND	0.07	ND
18:3n-6	0.50	0.39	0.54	0.27
18:3n-3	0.22	1.30	0.57	0.87
20:3n-6	10.80	8.20	8.49	18.47
20:3-3	ND	0.54	ND	0.22
Trienes	11.55	9.89	9.67	19.83
16:1n-3	0.08	0.07	0.41	0.17
20:4n-5	34.49	23.54	25.29	9.10
20:4n-3	0.12	0.26	0.11	0.71
22:4n-6	2.77	3.17	2.86	2.78
Tetraenes	37.46	27.04	28.67	12.76
20:5n-3	2.59	5.64	5.16	7.47
21:5n-6	0.26	0.65	0.79	1.49
22:5n-6	1.03	1.97	0.74	0.99
22:5n-3	1.20	2.36	1.13	2.80
Pentaenes	5.08	10.62	7.82	12.75
22:6n-3	0.94	1.61	0.78	2.64

(6.09-8.89%). Palmitoleic acid and 20:1n-11 were the major monoene fatty acids. The predominant omega-6 fatty acid in the three *Holothuria* spp. was arachidonic acid (23.54-34.49%). The fatty acid concentration of 20:3n-6 was significant in all species. The concentrations of docosahexaenoic acid (< 3.0%) and eicosapentaenoic acid (< 7.5%) were comparable to the *Echinoidea* spp. (Takagi *et al.*, 1980) and *S. droebachiensis* (Takagi *et al.*, 1988) reported earlier. Linoleic and linolenic acids were present in appreciable amounts and similar levels found in *S. droebachiensis* (Takagi *et al.*, 1988).

Table 2. Mineral composition (in μg g^{-1} dry weight)

Mineral	*Holothuria edulis*	*Holothuria impetius*	*Holothuria fascopundata*	*Bohadschia marmorata*
Na	76081	62014	49440	47185
K	6193	7708	5187	4576
Ca	24239	21313	33190	9691
Mg	15147	11559	12786	9350
Fe	81.1	50.10	105.60	26.00
Zn	20.3	30.40	12.00	8.50
Cu	4.3	1.80	2.60	23.10
Cd	0.54	1.48	0.65	0.17
Pb	1.90	0.39	0.30	0.46
Hg	<0.05	<0.05	<0.05	<0.05
As	0.13	0.12	0.10	0.10
Se	1.12	0.55	1.04	0.68

The mineral composition of the flesh is given in Table 2. The concentration of Na, K, Mg and Ca were relatively high compared to other metals and are important in human nutrition. The concentrations of heavy metals (Zn, Fe, Cu, Cd, Pb) and metalloids (Hg, As and Se) were relatively lower than the standards internationally accepted for direct or indirect human consumption (Nauen, 1983). Mercury levels were within the limits (WHO, 1976).

These results show that *Holothuria* spp. and *Bohadschia* sp. of Papua New Guinea are a rich source of omega-6 fatty acids (20:4n-5 and 20:3n-6) and dietary minerals.

References

Ackman, R.G. & Eaton, C.A. (1978) *Fettte Seifen. Anstrichm.*, **80**, 21

Ackman, R.G. (1988) *Atherosclerosis*, **70**, 171

Dyerberg, J. (1982) in *Nutritional Evaluation of Long-Chain Fatty Acids in Fish Oils* (Barlow, C.M. & Stansby, M.E., Eds.), p. 245, Academic Press, New York, USA

Folch, J., Les, M. & Sloane-Stanley, G.H. (1957) *J. Biol. Chem.* **226**, 497

Kinsella, J.E. (1986) *Seafoods and Fish Oils in Human Health and Disease*, Dekker, New York, USA

Napolitano, G.E., Ratnayake, W.M.N. & Ackman, R.G. (1988) *Comp. Biochem. Physiol.* **90B**, 875

Nauen, C.E. (1983) *Compilation of Legal Limits of Hazardous Substances in Fish and Fisheries Products*, FAO, Rome, Italy

Takagi, T., Eaton, C.A. & Ackman, R.G. (1980) *J. Fish. Aquat. Sci.*, **37**, 195

Takagi, T., Masaki, K., Itabashi, Y. & Ackman, R.G. (1986) *Lipids* **21**, 558

WHO (1976) *Environment Health Criteria 1-Mercury*, World Health Organization