[Jpn. J. Parasitol., Vol. 41, No. 1, 49-50, February, 1992]

Research Note

Polyunsaturated Fatty Acid Composition of *Strongyloides ratti* in Parasitic Phase

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(Accepted for publication; December 6, 1991)

Key words: *Strongyloides ratti,* fatty acids, linoleic acid, arachidonic acid, eicosapentaenoic acid, eicosanoids

We have previously reported the fatty acid composition of *Strongyloides ratti* in free-living generations (Minematsu *et al.*, 1990). In this paper, we report the fatty acid composition of *S. ratti* in parasitic phase compared with the previous result of free-living generations.

S. ratti adult worms were obtained under a stereoscopic microscope from the dissected small intestine of Wistar rats 4 and 8 days postinfection with 3,000 infective larvae (L_3). Likewise, parasitic L_3 and L_4 were obtained from the small intestine 3 days postinfection. The worms were washed with distilled water several times and stored at −20°C in lots for a few months. Total lipids in worms were extracted by the method of Folch *et al.* (1957) and analyzed by gas chromatography as previously described (Minematsu *et al.*, 1990). The gas chromatograph used was a JGC-20K TP (JEOL Ltd., Tokyo, Japan) equipped with a flame ionization detector. Gas chromatography was carried out on 200×0.2 cm glass columns packed with 10% Silar 10C on 100–120 mesh Uniport HP (Gasukuro Kogyo Inc., Tokyo, Japan).

The polyunsaturated fatty acids (PUFAs) contain two groups of fatty acids, $\omega 3$ and $\omega 6$ (The digit following the ω indicates the number of carbons ranging from the methyl end of the acyl chain to the terminal double bond), each having different metabolic pathways. As shown in the Table 1, the proportion of PUFAs in total fatty acids was nearly constant throughout the life cycle of *S. ratti.* However, the composition of individual PUFAs varied with stage of development. In the free-living adults and L_3, $\omega 3$ PUFAs such as C20:4 $\omega 3$ and C20:5 $\omega 3$ were abundant (Minematsu *et al.*, 1990). On the contrary, in the parasitic phase, $\omega 6$ PUFAs such as C20:4 $\omega 6$, C18:2 $\omega 6$ increased with age (Table 1). During the course of parasitic phase, the proportion of $\omega 3$ PUFAs tends to decrease gradually with the development, while that of $\omega 6$ PUFAs increased. The fatty acid composition of parasitic 8 day-old adult worms was similar to that of first-stage larvae (L_1). We reported previously that with the development of L_1, the proportion of $\omega 6$ PUFAs decreased and that of $\omega 3$ PUFAs increased conversely (Minematsu *et al.*, 1990). This change in free-living generations was in contrast to that in parasitic phase. Körting and Fairbairn (1971) studied the specific activities of β-oxidation, tricarboxylic acid cycle enzymes, and enzymes related to glycolysis and glycogenesis of *S. ratti.* They stated that the enzymatic constitution of L_1 resembles parasitic adult worms more closely than free-living adults or L_3, and probably L_1 might be in a period of metabolic transition and reorganization for the free-living. We have shown that the metabolism of $\omega 3$ PUFAs in L_1 is probably related to the determination of developmental direction as well as $\omega 6$ PUFAs (Minematsu *et al.*, 1990). In parasitic helminths, eicosanoids (lipoxygenase and cyclo-oxygenase products) have been demonstrated in *Taenia taeniaeformis* larvae (Leid and McConnell, 1983a, b) and in *Schisto-*

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Table 1 Fatty acid composition of *Strongyloides ratti* in parasitic phase in weight percent analyzed by gas chromatography

Fatty acid (No. carbon atoms : no. double bonds)	L_3	L_4	Adult	
			4 day-old	8 day-old
16:0	19.2 ± 1.1	18.9 ± 1.3	18.6 ± 0.7	14.1 ± 1.5
16:1 ω7	5.0 ± 0.5	3.5 ± 0.7	3.6 ± 0.3	2.9 ± 0.7
18:0	17.3 ± 0.7	17.3 ± 1.1	16.9 ± 0.9	14.6 ± 0.4
18:1 ω9	9.8 ± 0.2	7.7 ± 0.4	11.3 ± 0.6	15.8 ± 0.7
18:2 ω6	10.5 ± 0.2	9.2 ± 0.1	11.3 ± 0.6	22.0 ± 0.5
18:3 ω6	2.4 ± 0.7	2.0 ± 0.8	6.1 ± 1.3	5.2 ± 0.7
20:2 ω6	2.1 ± 0.3	1.5 ± 0.5	2.8 ± 0.5	2.6 ± 0.4
20:3 ω6	11.0 ± 0.5	13.7 ± 1.1	9.0 ± 1.1	4.3 ± 0.7
20:4 ω6	6.5 ± 0.5	6.9 ± 0.9	8.6 ± 1.0	10.3 ± 1.0
18:3 ω3	1.9 ± 0.4	1.4 ± 0.4	1.7 ± 0.3	2.7 ± 0.6
20:4 ω3	5.2 ± 0.4	5.6 ± 0.6	4.7 ± 1.3	2.0 ± 0.3
20:5 ω3	9.0 ± 0.8	12.2 ± 0.4	5.6 ± 0.9	3.4 ± 0.5
Total percent of ω6 polyunsaturated fatty acids	32.5	33.3	37.8	44.4
Total percent of ω3 polyunsaturated fatty acids	16.1	19.2	12.0	8.1
Total percent of ω6 and ω3 polyunsaturated fatty acids	48.6	52.5	49.8	52.5

Values were expressed as mean weight percentage (± SD) of five replications in total fatty acids listed.

soma mansoni cercariae (Fusco *et al.*, 1985). Eicosanoids derive from eicosapolyunsaturated fatty acids such as C20:3 ω6, C20:4 ω6, C20:5 ω3 and these are known to mediate an enormous range of cellular responses. In *S. ratti* L_3, prostaglandin E_2 and $F_{2\alpha}$ were detected by gas chromatography/mass spectrometry (Kimura, personal communication). Therefore, it may be possible that changes in PUFAs are related to the essential physiological changes of *S. ratti* through the life cycle.

References

1) Folch, L., Lee, M. and Stanley, G. H. S. (1957): A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226, 497–509.
2) Fusco, A. C., Salafsky, B. and Kevin, M. B. (1985): *Schistosoma mansoni*: Eicosanoid production by cercariae. Exp. Parasitol., 59, 44–50.
3) Körting, W. and Fairbairn, D. (1971): Changes in β-oxidation and related enzymes during the life cycle of *Strongyloides ratti* (Nematoda). J. Parasitol., 57, 1153–1158.
4) Leid, R. W. and McConnell, L. A. (1983a): PGE_2 generation and release by the larval stage of the cestode, *Taenia taeniaeformis*. Prostaglandins Leukotrienes and Medicine., 11, 317–323.
5) Leid, R. W. and McConnell, L. A. (1983b): Thromboxane A_2 generation by the larval cestode, *Taenia taeniaeformis*. Clinical Immunology and Immunopathology., 28, 67–76.
6) Minematsu, T., Yamazaki, S., Uji, Y., Okabe, H., Korenaga, M. and Tada, I. (1990): Analysis of polyunsaturated fatty acid composition of *Strongyloides ratti* in relation to development. J. Helminthol., 64, 303–309.