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Metabolism of palmitic, oleic and linoleic acids in Parapimelodus valenciennesi (Portenito)

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METABOLISM OF PALMITIC, OLEIC AND LINOLEIC ACIDS IN THE PARAPIMELODUS VALENCIENNESI (PORTENITO (*)

By: Delia V. Vazza

Research work done on the fat composition of fish shows that it is closely related to the feeding habits of the fish.

Several experiments were carried out using synthetic fat free diets which caused variations in the relative ratio of certain fatty acids and confirmed, on the other hand, the biosynthesis of these acids starting from acetate units. Moreover, Kelly, Reiser and Wood (1958) have observed changes and important processes of dehydrogenation by adding several types of fats.

Mead et al (1958) pointed out the ability of land animals (sic) to synthesize certain new saturated fatty acids, considering the three families of oleic, linoleic and linolemic acids. These acids are produced by elongation of the carbonate chain and the increase of the degree of unsaturation.

Studies carried out on fresh water fish in our country have made it possible to know more about the variety of acids contained and changes undergone when altering feeding habits.

The present study on the fresh water fish Parapimelodus Valeenciennesi (Portenio) links the composition of the diet administered, to matabolic processes and changes which may produce saturated (fatty) acids such as the palmitic and non-saturated acids such as the oleic and linoleic acids. The latter is well known for its property of being a fatty acid indispensable in the diet and the lack of which produces specific disorders.

EXPERIMENTAL PART 17

Preparation of synthetic diets

1. A fat-free synthetic diet was prepared by the Kelly, Reiser and Wood formula and three other special ones based on the previous one plus an aggregate of 10% of methyl oleate in the first, #10% of methyllineate in the second and #10% methyl palmitate in the third. These esters were obtained for their corresponding fatty acids esterified by methanol in a sulphuric solution and purified by vacuum distillation in a fractionating column. The linoleic acid was obtained from sunflower seed oil by the process of adduction (sic-RV.) with area to preserve its cis (sic-RV.) structure

Gas-liquid abromatography was used to analyse the quantitative and qualitative composition of same. Obtained was 95% pure methyl oleate, 92,58% pure linoleate and 99% pure palmitate.

2. Conservation of fish, extration and fractionating of total lipids.

About 200 specimens of Parapimelodus Valenciennesi (Portenits) approximately 4 months old caught in April 1961 were used in this experiment. They were placed in aquaria filled with fresh water at 20°C and constant air bubbless. During 55 days fish was given a fattess synthetic diet in order to cause a state of deficiency. At the end of this period the fish was divided in four lots to be subject to the different aforementioned diets. Lot No. 1, composed of 25 fish, was subject to a deficient diet with aggregate of methyl oleate during 23 days; lot No. 2, composed of 25 fish, was fed with diet based on linoleate of methyl during 15 days; lot No. 3 composed of 15 fish, was subject to a deficient diet with palmitate of methyl during 15 days; and lot No.4, composed of 50 fish, continued with a diet lacking fatty acid during 12 more days. Then the fish of the four lots were frozen to death in order to extract total lipids. For such a purpose, the Tolch et al method (1951) was followed, using a mixture of chloroform-methanol (2:1).

In order to get methylic esters they were interesterified and sublimated by the Shoffel and Ahrens method (1959). Then fatty acids were identified and quantitatively analyzed by gas-liquid chromatography, using a Pye column of 1.22 m. long and a Lovelock type ionization detector, using argon during the mobile stage and Reoplex 400 at 5% and 30%, Apiezon N at 10% and adipate of polyethyleneglycol at 15% during the stationary stage. Celite 545 (80.120 mesh B.D.H.) was used, as the packing in the column. Chromatographies were performed under the following conditions:

Temperature: 180°C and 200°C

Eluting gas pressure 516.97 and 620.36 mm. of Hg.

Recorder speed: 10 min/inch

Voltage applied to the detector: 1,000 and 1,250 volts.

Detector sensitivity: x10

Subsequently these esters were hydrogenated and chromatografied again to identify certain saturated (fatty) acids. Phospholipids were extracted from a part of lipids, by adsorption with silicic acid and a subsequent solution with methanol. Fatty acids in these were identified and quantitatively analyzed in the same way as the total lipids. Also total lipids and separated phospholipids were extracted from fish the death of which occurred by natural causes.

Results.
Table 1

Composition of fatty acids from total lipids of the Parapimelodus Valenciennesi (Porténito) fed with synthetic diet.

No.	acid:	natural diet.	deficient (lot 4)	deficient plus palmitate lot 3	deficient plus linoleato lot 2	deficient plus oleate lot 1
2	C11					
4	C12					
6	C13					
7	C14r					
8	C14					
9	C14:1					
10	C15r'					
11	C15					
13	C16r(iso)					
14	C16					
15	C16:1					
16	C17r'					
17	C17					
18	C17:1 or C16:3					
19	C18r(iso)					
20	C18					
21	C18:1					
22	C18:2					
23	C19	Traces				
24	C19:1					
25	C18:3					
27	C20					
28	C20:1					
29	C20:2				Traces	
30	C20:3					
31	C20:3 or C21	Traces				
32	C20:4					
33	C20:5'	Traces	Traces		Traces	
34	C20:5					
35	C22:?					
36	C22:?					Traces
37	C22:4?					
38	C22:5					
39	C22:5'					

Table 11.

Composition of fatty acids from total lipids of the Parapimelodus Valenciennesi (Porténito) fed with synthetic diet. (natural death)

No.	acid	deficient lot 4	deficient plus linoleate (lot 3)	deficient plus oleate lot 1.
2	C11			
3	C12r(iso)			
4	C12			
5	C13r'			
7	C14r(iso)			
8	C14			
10	C15r'			
11	C15			
12	C15:1			
13	C16r(iso)			
14	C16			
15	C16:1			
16	C17r'			
17	C17			
18	C17:1 or C16:3			
19	C18r (iso)			
20	C18			
21	C18:1			
22	C18:2			
24	C19:1		Traces	
25	C18:3			Traces
26	C19:2 or C20r?			
27	C20			
28	C20:1			
29	C20:2			
30	C20:3			
31	C20:3 or C21			
32	C20:4			
33	C20:5'	Traces	Traces	Traces
34	C20:5			
35	C22:?			
37	C22:4?			
38	C22:5			
39	C22:5'			

Table III

Composition of fatty acids from phospholipids of the Parapimelodus Valenciennesi (Porténito) fed with synthetric diet.

No.	acid	deficient (lot 4)	deficient plus palminate lot3	deficient plus linoleate lot 2	deficient plus oleate lot 1 (natural death).
1	C11r'				
3	C12r(iso)				
5	C13r'				
6	C13	Traces			
7	C14r(iso)				
8	C14				
10	C15r'				
11	C15				
12	C15:1			Traces	
13	C16r(iso)				
14	C16				
15	C16:1				
16	C17r'				
17	C17		Traces		
18	C17:1 or C16:3				
19	C18r(iso)				
20	C18				
21	C18:1				
22	C18:2				
23	C19		Traces		
25	C18:3				
26	C19:2 or C20r?				
27	C20		Traces		
28	C20:1				
29	C20:2				
30	C20:3				
31	C20:3 or C21				
32	C20:4				
33	C20:5'		Traces		
34	C20:5				
35	C22:?	Traces	Traces		
37	C22:4?				
38	C22:5				
39	C22:5'				
40	C22:6				

r: acid branched before iso.

Table IV.

Composition of fatty acids from total lipids of the Parapimelodus Valenciennesi (Porténito) fed with a fat-free synthetic diet with an aggregate of linoleate of methyl.

No.	acid	lot 2	lot 3 (natural death).
8	C14		
10	C15r'		
11	C15		
13	C16r(iso)		
14	C16		
15	C16:1		
16	C17r'		
17	C17		
18	C17:1 or C16:3		
19	C18r(iso)		
20	C18		
21	C18:1		
22	C18:2		
24	C19:1		Traces
25	C18:2		
26	C19:2 or C20r?		
27	C20		
28	C20:1		
29	C20:2	Traces	
30	C20:3		
31	C20:3 or C21		
32	C20:4		
33	C20:5'	Traces	Traces
34	C20:5		
35	C22:?		
37	C22:4?		
38	C22:5		
39	C22:5'		
40	C22:6		

r:acid branched before iso.

Table V.

Composition of fatty acids from phospholipids of the Parapimelodus Valenciennensi (Porténito) fed with synthetic diet(natural death).

No.	acid	deficient (lot 4)	deficient plus oleate (lot 1)
1	C11r'		
3	C12r(iso)		
5	C13r'		
7	C14r(iso)		
8	C14		
10	C15r'		
11	C15		
13	C16r(iso)		
14	C16		
15	C16:1		
16	C17r'		
17	C17		
18	C17:1 or C16:3		
19	C18r (iso)		
20	C18		
21	C18:1		
22	C18:2		
25	C18:3		
26	C19:2 or C20r?		
27	C20		
28	C20:1		
29	C20:2		
30	C20:3		
31	C20:3 or C21		
32	C20:4		
33	C20:5'		
34	C20:5		
35	C22:?		
37	C22:4?	Traces	
38	C22:5		
39	C22:5'		
40	C22:6		

r: acid branched before iso

CONCLUSION

1. It has been observed that the main components found in the "porténito" having a natural diet were [redacted] pair [redacted] acids; with the palmitic, oleic, stearic and palmitoleic acids predominating and the polyethylenic acid of 20 and 22 carbons found in a a lesser proportion, besides odd and branched acids.

2. The diet deficient in fatty acids has decreased the amount of linoleic, linolenic and arachidonic acids showing that they can not be synthesized from acetates as it occurs with polyethylenic acids of 20 and 22 carbons which require adequate precursors. The palmitic acid was synthesized and dehydrogenized to become palmitoleic acid.

3. Aggregates of oleate, linoleate and palmitate have caused an increase in their respective proportions in the total lipids, that is they are directly deposited.

4. The oleate in the diet causes a decrease in palmitic and palmitoleic acids, but it did not change polyethylenic acids of 20 and 22 carbons of which it is a precursor.

5. The linoleate has caused an increase in the content of eicosatetranoic (in all probability arachidonic of which it is a precursor), eicosatrinoic, eicosapentenoic, docosapentenoic and docosahexenoic acids. It has caused a decrease in palmitic and palmitoleic acids which are synthesized in smaller proportion.

6. A large part of palmitate aggregated to the diet seemed to be converted into palmitoleic acid by dehydrogenation.

7. Phospholipids have a larger amount of saturated acid polyethylenic acids and a lesser amount of oleic and palmitoleic acids. The deficient (diet) affected them less than to total lipids and their amount did not increase at the same rate when oleate and palmitate are added, while only an increase in eicosatetranoic may observed when adding linoleate.

8. A considerable amount of branched acids of 16, 17 and 18 carbons were found in the phospholipids and even a larger amount in fish the death of which occurred by natural causes.

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