This study was conducted to evaluate the effect of varying proportions of linseed, olive oils and sunflower in fish diets on the fatty acid composition of tilapia and catfish liver and muscles under aquaponics culturing system after 150 days of feeding period. A polyculture of two-month old tilapia and one-month old catfish were set in triplicate tanks for each experimental diet. Six experimental diets were formulated with freshwater shrimps as the main protein source and vegetable oil included as follows 100% linseed (diet 1), 75% linseed 25 olive oil (diet 2), 50% linseed 50% olive (diet 3), 25% linseed 75% olive (diet 4), 100% olive (diet5), 100% sunflower (diet 6) and commercial diet as a control feed. Gas chromatography was used to analyse fish tissue fatty acid profiles. Significantly high composition of n-3 fatty acids was observed in tilapia fed diet 1 ($p<0.05$) with DHA (C22.6) being the dominant n-3 fatty acids, 12.2% and 10.8% in tilapia muscles and liver respectively. The same trend was observed in catfish where muscle DHA was 10.4% and liver 9.7%. The muscle accumulation of n-3 fatty acid was significantly higher than liver in both fish. In both tilapia and catfish, the tissue n-3 fatty acids decreased with the reduction in linseed oil proportion in the diet feed. The changes in fish tissues fatty acid composition with diet oil composition indicated a strong influence of dietary oil composition on fish fatty acid profiles. The results strongly suggest that inclusion of linseed oil in the diet contributes to high n-3 fatty acids especially DHA and EPA which are of health benefit.