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Dietary Fish oil Lowers Plasma Butyrylcholinesterase Activity in Healthy Cats

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Abstract: Diets containing either fish oil or sunflower oil were fed to six healthy cats according to a cross-over design with feeding periods of 4 weeks. The diet with fish oil significantly lowered plasma butyrylcholinesterase activity. It is suggested tentatively that dietary fish oil could be of use in treatment and/or prevention of diabetes in cats

Key words: Dietar fish, plasma, butyrylcholinesterase

Introduction

The biological function of plasma butyrylcholinesterase has not been established, but the enzyme may be involved in lipid metabolism. High activities have been observed in human patients with obesity and/or hyperlipoproteinaemia (Kutty, 1980) and also in rats with induced diabetes (Patel *et al.*, 1990). The type of dietary fat affects the activity of butyrylcholinesterase. In rats, dietary fish oil versus corn oil raised the activity (Van Lith *et al.*, 1990), but in a study with piglets dietary fish oil lowered butyrylcholinesterase activity Rey *et al.*, 2000). In humans, fish consumption also caused a decreased activity of the enzyme (Van Houwelingen *et al.*, 1987). Possibly, the effect of fish oil on butyrylcholinesterase activity is species dependent. In the course of a study (Plantinga *et al.*, 2003) on the effect of dietary fish oil on the composition of cholesteryl esters in adult, healthy cats, we had the opportunity to determine the activity of butyrylcholinesterase in plasma. The results are reported here.

Materials and Methods

Six adult European Shorthair cats were used. The animals were housed in a group, but were individually fed for two 2-hour periods each day. During the feeding times, the diet was freely available. The study had a cross-over design with feeding periods of 4 weeks.

As base diet, a commercial dry cat food was used (Carocat, chicken/rice; Vobra B.V., Loosbroek, The Netherlands), but no fat was sprayed onto it while it was in meal form. The base diet was mixed with either menhaden oil or sunflower oil to a final level of 12.5 %, and was subsequently pelleted. Chemical analysis showed that the sunflower and fish oil diets contained 18.8 and 18.5 % crude fat and had n-3: n-6 polyunsaturated fatty acid ratios of 0.008 and 1.165, respectively. Mean intake of the fish-oil diet was 45.7 ± 13.9 g/day (mean ± SD, n = 6) and for the diet with sunflower oil it was 49.6 ± 18.4 g/day.

At the end of each feeding period, venous blood was obtained from the jugular vein and collected in heparinized tubes, while the cats were sedated with medetomidine and had been withheld from food for 8-12 hours. Plasma was isolated by centrifugation and kept at −20 °C until analysis of butyrylcholinesterase activity with a commercial kit (cat. No.1447297, Boehringer, Mannheim, Germany) and a Cobas-Bio autoanalyzer (Hoffmann- La Roche BV, Mijdrecht, The Netherlands).

Results and Discussion

The effect of dietary fat type on plasma butyrylcholinesterase is shown in Table 1. In each cat, the diet with fish oil lowered the activity. The decrease was statistically significant ($P < 0.05$; paired Student's t test), the group-mean decrease being 13 %. The results of this study support data in humans (Van Houwelingen *et al.*, 1987) and piglets (Rey *et al.*, 2000), showing that dietary fish oil lowers butyrylcholinesterase activity. It may be noted that butyrylcholinesterase activity in the cats was five-fold higher than the activity found in piglets (Rey *et al.*, 2000) and 25-fold higher than that reported for rats (Van Lith *et al.*, 1990). The assays were done using the same substrate, i.e. butyrylthiocholine. Thus, there is marked species difference with regard to the activity of plasma butyrylcholinesterase.

In rats, the induction of diabetes by streptozotocin caused a rise in butyrylcholinesterase activity while treatment with insulin resulted in normalization of the activity (Patel *et al.*, 1990; Annapura *et al.*, 1991). Administration of a specific inhibitor of butyrylcholinesterase after induction of diabetes reversed the glycaemia (Annapura *et al.*, 1991). In human patients with type 1 or type 2 diabetes butyrylcholinesterase activity was elevated (Abbot *et al.*, 1993). Diabetes mellitus is fairly common in the cat. The present observation that fish oil feeding lowered butyrylcholinesterase activity in cats could imply that fish oil might decrease the negative effects of diabetes and/or is protective. There is evidence that in humans the intake of fish could lower the risk of developing diabetes

Table 1: Effect of dietary fat type on plasma butyrylcholinesterase activity in individual cats

Cat No.	Plasma butyrylcholinesterase activity (U/L)	
	Sunflower oil	Fish oil
1	3153	2692
2	3447	3427
3	3035	2176
4	4092	3265
5	1842	1726
6	3433	3251

mellitus (Storlien *et al.*, 1996).

References

Abbot, C. A., M. I. Mackness, S. Kumar, A. O. Olukoga, C. Gordon, S. Arrol, D. Bhatnagar, A. J. M. Boulton and P. N. Durrington, 1993. Relationship between serum butyrylcholinesterase activity, hypertriglyceridaemia and insulin sensitivity in diabetes mellitus. Clin. Sci., 85: 77-81.

Annapura, V., I. Senciall, A. J. Davis and K. M. Kutty, 1991. Relationship between serum pseudocholinesterase and triglycerides in experimental induced diabetes mellitus in rats. Diabetologia, 34: 320-324.

Kutty, K. M., 1980. Biological function of cholinesterase. Clin. Biochem., 13: 239-234.

Patel, B. N., M. I. Machness, D. W. Harty, S. Arrol, R. P. Boot-Handford and P. N. Durrington, 1990. Serum esterase activities and hyperlipidaemia in the streptozotocin-diabetic rat. Biochim. Biophys. Acta, 1035: 113-116.

Plantinga, E. A. and A. C. Beynen, 2003. The influence of dietary fish oil versus sunflower oil on the fatty acid composition of plasma cholesteryl-esters in healthy, adult cats. J. Anim. Physiol. Anim. Nutr., 87: 373-379.

Rey, A. I., A. B. Schellingerhout, A.G. Lemmens and A.C. Beynen, 2000. Dietary polyunsaturated fatty acids and plasma butyrylcholinesterase activity in piglets. Int. J. Vitam. Nutr. Res. 70: 24-25.

Storlien, L. H., L. A. Baur, A. D. Kritekos, D. A. Pan, G. J. Cooney, A. B. Jenkins, G. D. Calvert and L. V. Campbell, 1996. Dietary fats and insulin action. Diabetologia, 39: 621-631.

Van Houwelingen, R., A. Nordøy, E. Van der Beek, U. Houtsmuller, M. De Metz and G. Hornstra, 1987. Effect of a moderate fish intake on blood pressure, bleeding time, hematology, and clinical chemistry in healthy males. Am. J. Clin. Nutr., 46: 424-436.

Van Lith, H. A., S. Herman, X. Zhang, J. G. P. Van der Palen, L. F. M. Van Zutphen and A. C. Beynen, 1990. Influence of dietary fats on butyrylcholinesterase and esterase (ES-1) activity in plasma of rats. Lipids, 25: 779-786.