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Original article

Different postprandial metabolic patterns after the consumption of fish oil and lard in healthy Chinese individuals

Les modèles métaboliques postprandiaux sont différents après la consommation d'huile de poisson et de lard chez des sujets chinois en bonne santé

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Abstract

Aim. – It is well known that nutritional intervention has positive effects on the secondary prevention of coronary heart disease. Different fat compositions of meals may alter postprandial plasma lipid patterns, which can further influence lipid metabolism in vivo.
Methods. – In the present study, we investigated postprandial plasma lipid parameters in twenty healthy volunteers after eating fat meals either with 80 gram lard or 80 gram fish oil. Blood samples were drawn at 0, 0.5, 1, 2, 3, 5 and 7 hours and plasma levels of total triglycerides (TG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were determined.
Results. – It demonstrated that postprandial plasma concentrations of TG, TC and LDL-C were significantly lower whereas HDL-C was higher after eating fish oil compared to the consumption of lard. Moreover, comparing the individuals with or without dyslipidemic family history, the healthy individuals without family history of dyslipidemia after eating fish oil had even lower postprandial plasma TG and LDL-C ($P < 0.05$) than the subjects with the family history. It is concluded that postprandial response following fish oil could be as a result of reduced TG, TC and LDL-C, and increased HDL-C.
Conclusions. – Postprandial responses following fish oil consumption may reduce TG, TC and LDL-C plasma levels, and increase HDL-C level. Individuals with dyslipidemic family history may have enhanced postprandial response than the individuals without dyslipidemic family history.

Keywords: Postprandial; Lipid metabolism; Fish oil; Lard; Healthy individuals

Résumé

Objectif. – Les interventions nutritionnelles peuvent avoir des effets positifs en prévention secondaire des maladies coronariennes. La composition en lipides des repas influence le contenu plasmatique lipidique postprandial, ce qui peut jouer un rôle dans le métabolisme lipidique in vivo.
Méthodes. – Les lipides plasmatiques postprandiaux de 20 volontaires sains ont été étudiés après la consommation de 80 g de lard ou d'huile de poisson. Des prélèvements sanguins ont été réalisés au temps initial, puis à une demi-heure, une, deux, trois, cinq et sept heures, et les triglycérides (TG), le cholestérol total (TC), la fraction à haute densité du cholestérol (HDL-C) et la fraction à faible densité (LDL-C) ont été mesurés dans le plasma.

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Résultats. – Après consommation d'huile de poisson, par comparaison avec une consommation de lard, les niveaux de TG, TC et LDL-C étaient plus bas, et le niveau de HDL-C plus élevé. De plus, après la consommation d'huile de poisson, les sujets sans antécédent familial de dyslipidémie avaient des niveaux plasmatiques de TG et LDL-C plus bas ($p < 0{,}05$) que ceux ayant des antécédents familiaux.
Conclusions. – La consommation d'huile de poisson pourrait participer à la réduction des niveaux plasmatiques de TG et d'HDL-C, et à une augmentation du niveau d'HDL-C. Les sujets ayant des antécédents de dyslipidémie familiale pourraient particulièrement bénéficier de consommer de l'huile de poisson.

Mots clés : État postprandial ; Métabolisme lipidique ; Huile de poisson ; Sujets sains

1. Introduction

It has been speculated that the annual incidence of coronary artery diseases (CAD) will be rapidly increased by more than 50% in the coming 20 years in China [1]. For more than two decades, the different health promoting disciplines have conducted research and identified that hypertension, dyslipidemia and cigarette smoking function as potent, but modifiable risk factors of CAD. With the improvement of people's living standard and life rhythm acceleration, the prevalence of dyslipidemia has significantly increased in China during the last decade [2–4].

It has been well documented that lifestyle modifications and/or eviction of potential additive cardiovascular risk factors may be considered as the first step for preventing CAD before clinical medications. A nutritional intervention, i.e., decreasing intake of omega-6 (N-6) fatty acids and increasing consumption of omega-3 (N-3) fatty acids, was demonstrated to be efficient for the secondary prevention of coronary heart disease (CHD) [5,6]. N-3 polyunsaturated fatty acids (PUFA), especially eicosapentanoic acid (EPA) and docosahexaenoic acid (DHA), have been confirmed to have positive effects on the prevention of CHD [7]. It has been demonstrated that hyperpostprandial lipemia may also involve in the initiation and progression of CHD [8–10].

Postprandial lipemia may refer to a series of events which occurs following the ingestion, absorption and metabolism of a fat-rich meal, and which may induce production of atherogenic lipoprotein particles, including chylomicron remnants and small dense low-density lipoprotein (small dense-LDL) and a reduction of anti-atherogenic high dense lipoprotein (HDL) particles [11]. At the meanwhile, hyperpostprandial lipemia may also initiate and enhance the process of thrombosis [12]. It has been suggested that the postprandial response is different because of difference of individuals, also related to the fat compositions of fat meals [13,14], and lard consumption is in the traditional feeding habits in China. In the present study, we examined postprandial plasma lipid changes after testing fat meals containing high amounts of lard or fish oil and further investigated the postprandial lipid parameters in the individuals with or without family history of dyslipidemia.

2. Materials and methods

2.1. Study design and test meals

Twenty healthy volunteers, with a mean age of 22.9 ± 1.48 years, a mean weight of 61.4 ± 9.4 kg and a mean BMI of 21.6 ± 1.57 kg/m^2 participated in the present study. There were four healthy volunteers with history of dyslipidemia and sixteen healthy volunteers without history of dyslipidemia in our study, and there was no difference of the mean weight and BMI between these two groups. All participants provided informed consent prior to the study, which was approved by the Ethics Committee of the Affiliated Hospital of Nanjing Medical University, Changzhou No. 2 People's Hospital. The following inclusion criteria were used: fasting plasma cholesterol ≤ 6.22 mmol/l, fasting plasma triacylglycerol (TG) ≤ 2.0 mmol/l, Hb > 13.0 g/dl and γ-glutamyl transferase ≤ 50 units/l, strenuous exercise ≤ 90 min/week and participants with no habitual consumption of any fatty acid supplement or medication known to affect lipid metabolism. Criteria of the family history of dyslipidemia was defined as at least one of the individual's parents with one of the dyslipidemic profiles according to the Chinese guidelines on prevention and treatment of dyslipidemia in adults [15].

Fish oil capsules (Pharbio Omega-3 Forte) that contains 70% N-3 free fatty acids were purchased from Sweden (Cederroth AB, Upplands Väsby). The lard was purchased from local supermarket and was commonly used for cooking typical Chinese foods. The test meals contained about 80 gram fish oil or lard together with toast bread (about 100 gram). Both test meals contained approximately about 4000 kJ (approximately 957 kcal) that was about 58% fat, 8% protein and 34% carbohydrates in each meal.

Participants were asked to refrain from eating oily fish or from doing strenuous exercise for 24 h and to fast for 12 h before having test meals, but could consume water freely. A 21 gauge, 32 mm venous catheter was inserted into the antecubital vein of the forearm and a fasting sample (5 ml blood) was collected in a tube containing heparin sulphate. The volunteers were allowed to have one to two cups of Chinese green tea or water and test meals were eaten within 20 minutes. Blood samples were drawn at 0.5, 1, 2, 3, 5 and 7 h after the test meals for the lipid analyses. Each volunteer ingested each of two test meals using a Latin square design and a 4-week wash-out period between test meals.

2.2. Biochemical analysis

Blood samples were immediately centrifuged at 4 °C, 3000 rpm for 30 min, the plasma was collected and stored at −20 °C before further determinations. All samples were biochemically determined at the same time in order to eliminate