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Original Research Article

# The evaluation of selected shellfish as a source of niacin in nutrition and therapy of modern human

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ABSTRACT

*Introduction:* The presence of fish and seafood in the diet of people at high risk of heart disease, pregnant women and the elderly is conducive to the preservation of health. Food originating from the sea is a good source of niacin and should be consumed by all, regardless of age and/or physiological state. Therefore, it is recommended by physicians and nutritionists.

*Aim:* The aim of this study was to determine the content of niacin in selected seafood and to evaluate these products as a potential source of niacin.

*Material and methods:* The content of niacin was determined by the microbial method. The vitamin was extracted from the analyzed samples using enzymatic hydrolysis.

*Results:* A portion of 100 g seafood implements the standard daily requirement in range of 4.43%–8.21% for women and 3.88%–7.19% for men, respectively.

*Discussion:* Fish and seafood consumption has a tendency to increase all over the world, whereas in some countries (Poland) it persists insufficient with a declining tendency. Considering high nutritive value, the analyzed shellfish are recommended as valuable ingredient of diet. Increased consumption of seafood might contribute to reduce the risk of civilization diseases morbidity.

*Conclusions:* The niacin analysis that was conducted showed differences between the various types of seafood. Among the analyzed seafood, the best source of niacin came from the meat of clams.



## 1. Introduction

### 1.1. Nutrition

Nutrition is one of the major factors affecting human development, health and well-being. The presence of seafood in the diet of people at high risk of heart disease, pregnant women and the elderly is conducive to the preservation of health. Food originating from the sea is a good source of vitamins A, D, B group (niacin, $B_6$, $B_{12}$), long-chain n-3 polyunsaturated fatty acids (PUFAs), and rare microelements (iodine, selenium, fluorine), and should be consumed by all, regardless of age and/or physiological state.[1–4] Its protein is

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highly digestible due to low connective tissue content.[5] Therefore, it is recommended for children, pregnant women and the elderly. The lack (or excess) of B group vitamins contributes to developing specific diseases, which are related to modern lifestyle, such as hyperlipidemia, hypertension, obesity or cardiovascular disorders which are so common in these days among industrialized countries. Making healthy food choices is an integral part of cardiovascular risk management.[6,7]

Recent studies have shown that most species of shellfish are a good source of PUFAs. In particular, crab, oysters and mussels contain as much n-3 as some oil-rich fish.

PUFAs reduce plasma triglyceride concentrations and have been postulated to reduce type 2 diabetes.[8,9] Eating seafood products regularly reduces ischemic heart disease, and dietary supplementation of n-3 marine triglycerides improves survival in patients who have recently had a myocardial infarction. PUFAs, including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), inhibit platelet function, prolong bleeding time, have an anti-inflammatory effect and reduce plasma fibrinogen. EPA and DHA have been shown to have cardioprotective effect.[6] EPA substitutes for arachidonic acid in cell membranes and gives rise to 3-series prostaglandins and thromboxanes and 5-series leukotrienes. A preparation of n-3-acid ethyl esters is licensed in the United Kingdom for the prevention of recurrent events after myocardial infarction in addition to the treatment of hypertriglyceridemia; it causes less of an increase in low-density lipoprotein (LDL) and fewer problems with fishy odor, weight gain and dyspepsia than the older fish oil preparations that were popular in the past.

Specific dietary pattern that includes seafood may be associated with lower risk of metabolic syndrome in adults.[10] High consumption of fish and n-3 fatty acids was significantly associated with a lower risk of metabolic syndrome among men.[11]

### 1.2. *Niacin*

Niacin (vitamin $B_3$), the common name for both nicotinic acid and nicotinamide, is a vitamin, and as such is essential for many important metabolic processes. The main coenzymes derived from nicotinic acid are nicotinamide adenine dinucleotide ($NAD^+$) and nicotinamide adenine dinucleotide phosphate ($NADP^+$). Nicotinamide nucleotide coenzymes catalyze many chemical reactions within the glycolytic pathway/tricarboxylic acid cycle and pentose phosphate pathway of glucose metabolism. Niacin can be synthesized in the human body from the essential amino acid L-tryptophan. Approximately 60 mg of L-tryptophan yields 1 mg of niacin, so foods containing a balanced amount of protein, as fish and shellfish, are important contributors to the total niacin equivalent intake.

### 1.3. *Niacin in therapy*

Niacin is a broad spectrum lipid regulating agent, in pharmacological doses, and was proven to exert many favorable effects on cholesterol metabolism, including reduction in total cholesterol, decreases very-low-density lipoprotein (VLDL), triglycerides secretion, LDL cholesterol (LDL-C), lipoprotein(a), and augmentation of high-density lipoprotein cholesterol (HDL-C).[12–14] LDL-C is the primary goal of therapy, although there is considerable evidence that the triglyceride-rich VLDL and the remnant lipoproteins are also atherogenic.[15]

Niacin is known to suppress adipose tissue lipolysis in individuals with atherogenic dyslipidemia, improving hypertriglyceridemia and elevated plasma free fatty acid (FFA) concentrations.[16] Treatment with niacin (nicotinic acid) and its analogs has been shown to reduce FFA concentrations, and flux and improve insulin sensitivity.[17]

Long-term administration to survivors of myocardial infarction reduced mortality in the Coronary Drug Project (CDP) trial, but unintended effects limit its clinical use.[18] New analogs of nicotinic acid can be available during the onset of an acute coronary syndrome to maintenance heart contraction and to counter ventricular arrhythmias.[19]

Niacin reduces cardiovascular disease events and the progression of atherosclerosis, in patients with established vascular disease. It can occur through a mechanism not reflected by changes in HDL-C concentration.[20,21]

Nicotinic acid has been used in gram quantities as a lipid-lowering agent, as an adjunct to statin in dyslipidemia, or used alone.[13,14,22] Current treatment guidelines recommend lowering elevated LDL-C levels with a statin as the primary lipid-modifying intervention to reduce cardiovascular risk in patients with type 2 diabetes mellitus, or metabolic syndrome.[23] Niacin therapy for three years in subjects with normal baseline glucose levels is associated with an increase in blood glucose levels and the risk of the development of impaired fasting glucose, with a significant reduction in coronary stenosis progression and clinical cardiac events.[24]

Niacin administration significantly reduces oxidative stress in patients with hypercholesterolemia and low levels of HDL-C and inhibits vascular inflammation.[25,26]

Infusion of intravenous niacin provides a model for acutely improving dietary fat storage, perhaps by suppressing of lipolysis in visceral adipose tissue and a reduction in fractional spillover.[27]

The current review advocates an initially slow niacin dose escalation from 0.5 g to 1.0 g daily during eight weeks and then from 1.0 g to 2.0 g in a single titration step (if tolerated).[28] A maximum daily dose of niacin at 2.0 g can be given once daily at night in rising doses.

A modified-release preparation is better tolerated. Adverse effects include flushing, palpitations and gastrointestinal disturbance. Flushing may be minimized by taking niacin with meals (or at bedtime with a low-fat snack), avoiding exacerbating factors (alcohol or hot beverages), and taking 325 mg of aspirin 30 min before niacin dosing or with laropiprant.

Another noted side effect of niacin therapy is an observed increase in serum glucose levels. High doses can disturb liver function, impair glucose tolerance, and precipitate gout by increasing the circulating urate concentration.

## 2. Aim

The aim of this study was to determine the niacin content in shellfish and assess the analyzed products as a source of niacin in the human diet.