

Dairy Products as Source of Angiotensin-I-Converting Enzyme-Inhibitory (Ace-I) Peptides

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Introduction

The nutraceutical benefits derived from the protein component of dairy products on human health are now widely acknowledged. These are the result of the close association between milk protein quality and proteolytic activity of starter and non-starter bacteria, which leads to generation of secondary metabolites with health-promoting properties. Lactic acid bacteria (LAB) such as *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus* and probiotics such as *Lactobacillus acidophilus*, *Lactobacillus casei*, *Bifidobacterium bifidum* are commonly used as starter cultures in the dairy industry. The proteolytic activity of these LABS along with non-starter LAB, naturally present in milk, generates peptides with a wide array of biological activities, including antihypertensive, antithrombotic, opioid, immunomodulatory, antimicrobial, and antioxidant activities [1].

In recent years, the bioactive peptides with antihypertensive activity, which mainly occur through the inhibition of the angiotensin-I-converting enzyme (ACE), have gained a great deal of attention in the scientific world. ACE is a key enzyme in the regulation of blood pressure; in particular, it catalyzes the conversion of angiotensin I into angiotensin II, a potent vasoconstrictor, and inactivates bradykinin, a vasodilator [2]. Elevated ACE activity could lead to higher Angiotensin II level, giving rise to an increase in blood pressure [3]. Hypertension, closely associated to the eating habits of industrialized countries, is one of the risk factors for coronary heart disease and stroke [4].

Both casein and whey proteins, in particular α -lactalbumin and β -lactoglobulin, are a rich source of ACE-inhibitory (ACE-I) peptides [5]. These bioactive peptide sequences are usually 2-20 amino acid residues in length, encrypted and inactive within proteins but, once released, they can be absorbed through intestine to enter the blood circulation or they can produce local effect within the gastrointestinal tract [6]. They can be released in an active form by enzymes during cheesemaking, microbial fermentation and ripening and are therefore, naturally present in dairy products, whereas for the most part, they are released from milk protein sequences during gastrointestinal digestion by gastric and pancreatic enzymes [7,8].

The antihypertensive effect of fermented milk products was widely demonstrated by Sipola et al. [9] in rats and it was confirmed by Seppo et al. [10] and Jauhiainen et al. [11] in mildly hypertensive human subjects. Crippa et al. [12] showed that a daily dietary integration for 2 months with 30 g of Grana Padano cheese (typical Italian cow-milk cheese) effectively reduced blood pressure (146/91 vs. 134/83 mm Hg, before and after treatment, respectively) in hypertensive patients. Moreover, it has been demonstrated that the antihypertensive activity of protein-derived peptides is in close synergy with the milk components: Jauhiainen et al. [13] reported that fermented milk product containing ACE-I peptides, but no pure ACE-I peptides in drinking water, attenuated the development of hypertension in an animal model. It should be emphasized that bioactive peptides can also exert antihypertensive activity by interaction with opioid receptors having vasodilatory effect and inhibiting the release of endothelin-1 (vasoconstrictor peptide) [14,15].

Taken together the results of these studies highlight that the intake of dairy products leads to an enrichment of ACE-I peptides in human body which may be useful in the non-pharmacological prevention of hypertension development.

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