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Vitamin C content in Latvian cranberries dried in convective and microwave vacuum driers

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Abstract

Cranberries belong to a group of evergreen dwarf shrubs or trailing vines in the genus *Vaccinium* subgenus *Oxycoccus*. Traditionally they grow in acidic bogs throughout the cooler parts of the world; when cultivated are grown on low trailing vines in great sandy bogs. The research focuses on the study of vitamin C changes in Latvia grown wild (*Vaccinium oxycoccus L.*) and cultivated (*Vaccinium macrocarpon Ait.*) cranberries during convective and microwave vacuum drying. Latvian wild cranberries and cultivated cranberry varieties 'Early Black', 'Ben Lear', 'Stevens', 'Bergman' and 'Pilgrim' from Kurzeme region harvested in 2010 were used for experiments. Mechanical and thermal pre-treatment of fresh berries was applied for better water evaporation in drying process. During experiments the berries were dried: in a convective air dryer by controlled hot air stream circulation velocity of 1.2 m s^{-1} at temperature +50±2 ºC. The berries were placed on the perforated sieve (diameter 0.185 m, diameter of holes – 0.002 m); the moisture content of dried berries was 9.0±0.1%. Following quality parameters were analysed during experiments: moisture content (oven-drying method) and vitamin C content (LVS EN 14130:2003). Experimentally it was ascertained that drying time of berries by various drying methods mainly depends on the pre-treatment manner. During the drying process moisture content of cranberries decreased from on average 86.94% to 9.00%, about ~10.00 times. Vitamin C is the least stable of all vitamins and it can be easily degraded during processing and storage. The most harmful factors to vitamin C content are the presence of oxygen, prolonged heating in the air ambiance and exposure to light. The initial content of vitamin C in wild and cultivated fresh cranberries was differing, which mainly depends on varieties' individuality. Current research proved that vitamin C content loss in cranberries processed by microwave vacuum drying method comparing with drying in convective cabinet type dryer was smaller.

Keywords: Cranberries; vitamin C; steam-blanching; convective drying; microwave vacuum drying.

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1. Introduction

Cranberries belong to a group of evergreen dwarf shrubs or trailing vines in the genus *Vaccinium* subgenus *Oxycoccus*. Traditionally they grow in acidic bogs throughout the cooler parts of the world; when cultivated are grown on low trailing vines in great sandy bogs. Berries are rich in a vitamin C, organic acids, minerals, aroma, and phenol compounds. Many cultivars and native species of berries exist with substantially higher antioxidant levels than others [1, 2]. Cranberries and their products have been historically associated with many positive benefits for human health. For many decades, cranberry juice has been widely used as a folk remedy to treat urinary tract infections. Cranberry juice extracts have also been suggested to exhibit anticancer effects and to inhibit the oxidation of low-density lipoprotein *in vitro*, potentially preventing the development of heart diseases [3]. Cranberries contain flavonoids including proanthocyanidins, anthocyanins, and flavonols, which may protect bone against resorption. The antioxidant capacity of proanthocyanidin has been reported to be stronger than vitamin C, vitamin E, and catechins [4]. Cranberries contain vitamin C (as evidenced by the presence of citric acid) and phytochemicals. Vitamin C is also an important antioxidant. It is important to recall that the antioxidants β-carotene and vitamin E protect water soluble substances from oxidising agents; vitamin C protects water soluble substances the same way [5]. Vitamin C is stable, since the pH value of a product is about 4, yet this vitamin is unstable due to product processing / storage conditions: air oxygen, light, and temperature +80 °C [6]. The importance of vitamin C in the diet is well understood and scientifically proved. Vitamin C is also involved in the metabolism of several amino acids [5, 7, 8 and 9]. Drying is one of the oldest methods of food preservation and it is a difficult food processing operation mainly because undesirable changes in quality because the removed water from a food product using conventional air drying, may cause serious damage to the dried product [10]. It is the most common and most energy-consuming food preservation process. With literally hundreds of variants actually used in drying of particulate solids, pastes, continuous sheets, slurries or solutions, it provides the most diversity among food engineering unit operations. Air-drying, in particular, is an ancient process used to preserve foods in which the solid to be dried is exposed to a continuously flowing hot stream of air where moisture evaporates. The phenomena underlying this process is a complex problem involving simultaneous mass and energy transport in a hygroscopic, shrinking system. Air-drying offers dehydrated products that can have an extended shelf life of a year but, unfortunately, the quality of a conventionally dried product is usually drastically reduced from that of the original foodstuff [11, 12]. Microwave drying is rapid, more uniform and energy efficient compared to a conventional hot air drying. In this case, the removal of moisture is accelerated and, further-more; heat transfer to the solid is slowed down significantly due to the absence of convection. Also because of the concentrated energy of a microwave system, only 20–35% of the floor space is required, as compared to conventional heating and drying equipment. However, microwave drying is known to result in a poor quality product if not properly applied [13, 14]. Water accounts for the bulk of the dielectric component of most food systems especially for high moisture fruits and vegetables. Hence, these products are very responsive to microwave applications and will absorb the microwave energy quickly and efficiently as long as there is residual moisture. Microwave application for drying therefore offers a distinct advantage. Proteins, lipids and other components can also absorb microwave energy, but are relatively less responsive. A second advantage of microwave application for drying of vegetables is the internal heat generation [15]. For the better water evaporation during drying process there are known many vegetable and fruit pre-treatment methods such as: halving or slicing [16], blanching in hot water [17], steam-blanching in order to inactivate enzymes activity [18] and perforation with needle (of 1 mm diameter) [19]. The current research focuses on the study of vitamin C changes in Latvia wild grown as well as cultivated cranberries during convective and microwave-vacuum drying.