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IMPACT OF PROCESSING AND STORAGE ON VITAMINS AND MINERALS IN JAMS MADE FROM BERRIES

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Forest berries represent a category of raw materials with remarkable nutritional and functional value due to their high content of vitamins, minerals, phenolic compounds, and natural antioxidants. Bilberries (*Vaccinium myrtillus*), raspberries (*Rubus idaeus*), blackberries (*Rubus fruticosus*), currants (*Ribes* spp.), and aronia (*Aronia melanocarpa*) are recognized for their high concentrations of vitamin C, manganese, potassium, iron, and bioactive compounds such as anthocyanins, flavonoids, and phenolic acids. Processing these fruits into jams enables their long-term utilization; however, technological processes and storage conditions significantly influence the nutritional composition of the final product.

Jam production generally involves intensive thermal treatments aimed at concentrating the product and ensuring microbiological stability. High temperatures and prolonged processing times lead to the degradation of heat-sensitive compounds, among which vitamin C is the most affected. Ascorbic acid is highly susceptible to oxidation in the presence of oxygen and elevated temperatures, and losses occurring during jam manufacture may exceed 50% of the initial vitamin C content of the fruits. This phenomenon is particularly important in the case of black currants and aronia, species known for their exceptionally high vitamin C concentrations.

In addition to vitamin C, B-complex vitamins may undergo moderate degradation during thermal processing. Thiamine, riboflavin, and folate exhibit varying degrees of temperature sensitivity, and their retention depends on processing time and product composition. In contrast, the fat-soluble vitamins, present in relatively low amounts in berries, are generally more stable, although oxidative processes may contribute to their decline during storage.

The importance of the processing method has been demonstrated by studies on berry-based products, which have shown that industrial vacuum-boiling systems provide superior preservation of bioactive compounds compared with traditional open-pan processing methods. Reduced oxygen exposure and shorter periods of heating contribute to higher retention of anthocyanins and antioxidant activity.

Unlike vitamins, mineral substances are considerably more stable during thermal treatments. Minerals are not degraded by heat because they are inorganic elements. Consequently, potassium, calcium, magnesium, phosphorus, iron, zinc, and manganese are largely retained after processing. Any losses are mainly associated with the transfer of minerals into the liquid phase, the removal of certain fruit components, or complexation reactions that may alter their bioavailability without affecting their total content. In most cases, mineral retention exceeds 90%, which explains the preservation of the mineral nutritional value of berry jams.

Prolonged storage, particularly at room temperature, further accelerates vitamin degradation, leading to a reduction in the functional value of the product. Nevertheless, even after processing, jams produced from these fruits remain important sources of bioactive compounds and minerals when compared with many other processed food products.

The application of modern processing technologies that minimize exposure to heat and oxygen, together with the use of appropriate storage conditions, represents an effective strategy for preserving the nutritional quality of berry jams.

Key words: *jam production*, *thermal processing*, *bioactive compounds*, *retention*, *bioavailability*.

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