

Insights on the use of gooseberries to develop food products with high bioactive properties

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Abstract

Nowadays, by increasing food diversity, we refer to increasing both, the amount and range, of foods rich in micronutrients consumption. In practice, this requires the implementation of programs that improve the availability, and access to different types of foods that are rich in micronutrients in adequate quantities. Increasing the diversity of the diet, is the preferred way to improve the nutrition of a population, because it has the potential to improve the intake of many nutrients, not just micronutrients. Ongoing research suggests that foods rich in micro and macronutrients also provide a number of antioxidants and probiotics that are important for protection against metabolic diseases and for improving the immune system. The purpose of this paper is to review the research carried out so far in the direction of the gooseberries exploiting and to identify possible directions of study in order to develop innovative products by exploiting the potential of these fruits. The factors responsible for preserving the bioactive properties of these fruits in the finished product will also be investigated. The information provided is of great interest for future directions in exploiting the bioactive potential of goosberries, as the food industry is constantly evolving, leading to a desire to improve or bring innovation to this sector.

Keywords: gooseberries, bioactive potential, nutritional value, innovative food products

The continuous concern of consumers for food products with health benefits has determined food specialists to be receptive to their requirements, focusing on the development of products with improved nutritional profile, without impairing sensorial characteristics. Research in recent years has shown that there are still untapped possibilities to capitalize on raw materials of local plant origin as valuable ingredients for the design of new foods with high added value.

Although nutrition plays a key role in the harmonious development of children and maintaining the health of adults, due to the fact that we are increasingly rushing, we often knowingly neglect it. To help those who still want to maintain a balanced diet, we chose as a research topic to enrich the nutritional value of food by adding gooseberries [1].

The main aim of this study is to investigate the possibility of developing products with improved antioxidant properties, high ascorbic acid content and bioactive compounds by adding gooseberries and using them as such to obtain low-sugar jams. The study starts from the current state of the biscuit and jam industry and aims to improve their qualities and properties by capitalizing on local raw materials, easy to obtain. Research highlights the antioxidant capacity, increasing the content of vitamin C but also increasing the value of total polyphenols and anthocyanins, by adding in different proportions to gooseberries.

The choice of this theme is based on the desire to obtain fortified foods through the use of fruits that are grown in our country and that can be easily used in the food industry. At the same time, we paid attention to the benefits obtained by consuming these foods.

The tendency to give more and more importance to a healthy lifestyle, makes this research a real necessity. This makes the second major impact of research to be social. Because we focus on making products with added value, with improved nutritional properties, the market segment we are targeting is quite wide.

Fortification with functional ingredients rich in polyphenolic compounds allows to increase the content of bioactive compounds in food, but this effect can be limited by many factors, including binding to the components of the food matrix. The effectiveness of fortification is limited by the interactions that may occur between polyphenols and proteins, polyphenols and starch or even between the polyphenolic compounds present. The strong affinity of polyphenols for proteins or other components of the matrix can lead to a decrease in the content of free forms, with a negative impact on their bioavailability. This aspect will be studied and taken into account for the design of new fortified foods [1].

Gooseberry (*Ribes uva-crispa*) belongs to the Grossulariaceae family and is grown mainly in hilly regions. The shrub has a height of 60 to 150 cm, arched branches with thorns and the fruit is ovoid or spherical, with a sweet-sour taste, many seeds and a green, yellowish or reddish color. It is generally with thorny branches, but there are also thornless varieties. Prefers cool areas with average annual temperatures of 8°C, medium-textured soils - sandy, loamy-sandy, sandy-clayey and withstands negative temperatures up to -32°C. The gooseberries, can have different colors, depending on the variety, the green ones being better known in our country [2].

A review of the studies carried out so far in this field is very useful for future directions in exploiting the bioactive potential of goosberries. The food industry is constantly evolving, leading to a desire to improve or bring innovation in this field. More and more consumers tend to look for products with enriched nutritional value, and to meet their demands, the major companies are looking for solutions by adding value to raw materials.

The aim of this work is to investigate the research carried out so far in the direction of the gooseberries exploiting and to identify possible directions of study in order to develop innovative products by exploiting the potential of these fruits.

2. Food fortification

Food fortification is the operation of adding essential nutrients (vitamins, minerals, amino acids, etc.) to a food, in order to increase its nutritional content. It offers the opportunity to improve people's lives today and is responsible for removing most deficiencies of vitamins and minerals. This process is the safest way to provide the necessary amount of micronutrients to the majority of the population in an efficient manner. Fortification is socially accepted, does not change eating habits, the sensory properties of food do not change, does not print odors, can be introduced quickly, and the benefits appear in a short time [1].

The introduction of nutrients in food is an effective way to prevent food imbalances due to deficiencies of various origins and, therefore, to ensure optimal health of the population. Fortified foods are obtained by supplementing with biologically active compounds some products poor or lacking in such nutrients. The purpose of the operation is to ensure maximum protection of the body and requires a synergistic and physiologically adapted nutritional association. The nutrients with which the supplement is made are proteins, amino acids, vitamins and minerals, and the most used vector foods are cereals and their derivatives, because they are widely produced in the diet [3].

The success of the fortification process depends on a number of factors, including the stability of the micronutrients added to the food. Their processing can affect the stability of vitamins present in food to the same extent as physical and chemical factors such as temperature, humidity, exposure to light or air, and acidic or alkaline environments. Exposure of the fortifier to one of these factors during the technological process, distribution or storage affects its stability. From this point of view, minerals are much more resistant to food processing than vitamins, but they also change when exposed to light, air or heat.

Cereals and their derivatives are the most common vector foods that can provide a number of nutrients in the daily diet, due to the fact that they are basic products in the diet of some segments of the population or even the entire population of a nation. They make up 50% of the world's food sources and, as a result, in all countries where food fortification programs have been developed, cereals are in first place.

Fortification in this case refers to proteins, vitamins B1, B2, PP, lately and folic acid and mineral salts, iron, calcium and possibly magnesium [4].

The idea behind the research in the doctoral thesis focused on the fact that so far there are limited studies on the use of gooseberries, as an alternative source of polyphenolic compounds, for the design of new formulas for biscuits and jams. The mentioned product categories represent an adequate matrix for the addition of nutrients and the use of gooseberries for this purpose is very attractive.

However, fortifying food is a very fine operation in terms of nutrient dosing, because excessive fortification can create, in some people, major disorders. For example, too much iron in bread or flour can increase the incidence of hemochromatosis. Massive iron absorption also increases the incidence of liver disease, including cirrhosis. Increased protein absorption can cause a negative calcium balance. Hypervitaminosis A causes abnormal skin pigmentation, fragility of the skeleton. Hypervitaminosis D leads to hypercalcemia, anorexia and, in extreme cases, mental retardation [1].

Increasing the diversity of the diet is the preferred way to improve the nutrition of a population, because it has the potential to improve the intake of many nutrients, not just micronutrients. Research shows that foods rich in micro and macronutrients also provide a number of antioxidants and probiotics that are important for protecting metabolic diseases and improving the immune system.

Another way to combat malnutrition with micronutrients is to introduce fortified foods. In general, food fortification is socially accepted and does not require changing eating habits, changes the quality characteristics of the product, can be introduced quickly, has nutritional benefits for target groups, is nutritionally and economically safe [5].

3. Possibilities to exploit the bioactive potential of gooseberries

3.1. Exploiting gooseberries to develop low-sugar jam formulas

In order to keep all these nutritional values as high as possible and not to add harmful ingredients, one of the most beneficial methods of capitalizing on gooseberries is to jam them.

The addition of sugar is not necessary, well-cooked gooseberries having a sweet-sour taste, perfect to be eaten as such or in various culinary combinations, such as pancakes, cakes or even meat, in this case being used as a sauce.

When obtaining the jam, the sugar was replaced with fructose, which is an organic compound, belonging to the class of saccharides, a monosaccharide of the ketohexose type, with fructose as their stereoisomer. After glucose, it is the most common monosaccharide. It occurs freely in sweet fruits and honey or combined in di-, tri- and polysaccharides. It is a solid substance, crystallized in the form of needles, with a sweet taste (it is the sweetest monosaccharide), soluble in water and methanol [6].

According to studies conducted at the University of Canberra, Australia, fructose consumption keeps blood sugar levels low, unlike other types of sugar, such as sucrose (glucose) or glucose. This phenomenon is explained by the fact that the chemical structure of fructose requires its transformation into glucose by the liver, prior to penetration into the blood, explains the author of a study published in the American Journal of Clinical Nutrition. The metabolic pathways by which fructose is absorbed differ from those of glucose, although the two have the same chemical formula. This process is called conversion and takes place over a longer period of time, compared to the galloping effect that sucrose has [7].

Plenty studies have indicated that the phytochemical content and corresponding antioxidant activity of fruits contribute to their protective effect against chronic and degenerative diseases. Fruits generally possess a high level of antioxidant activity, which is related to the levels of phenolic compounds in the fruit [8, 9]. The preservation of fruits by jam making is a considerable direction of the fruits processing, even if the antioxidant and sensorial characteristics of final products are strongly affected by factors like: raw material quality, thermal parameters, recipe manufacturing, storage conditions of final products, etc. [10, 11].

Jams with a low content of sugar were initially developed for diabetics and people with specific health conditions.

The food industry has been facing up with a new challenge in order to satisfy the consumers that is to develop low-calorie products with acceptable sensorial characteristics and competitive prices, by preferably employing the conventional processing equipment. Nowadays, the demands for low-calorie products have visibly risen in an attempt to alleviate the health problems, to reduce or stabilize the body weight, or because people are concerned about a healthy diet. Color stability and bioactive compounds content of red fruits or red fruits products is influenced by many factors: temperature, time of processing, pH, oxygen, water activity, storage conditions.

The quality of the color may influence consumer acceptability. Anthocyanins content has a critical role in the color quality of many fresh and processed fruits. During processing and storage, degradation and polymerization usually lead to its discoloration [12, 13]. During thermic processing, degradation and polymerization usually lead to anthocyanin discoloration [14, 15].

The research we carry out will allow the extension of the cushion on the stability of polyphenolic compounds depending on the dehydration conditions, in order to preserve the functional character of gooseberries.

Pectin uses. Pectin was first discovered in fruit juices in 1790 by the French chemist and pharmacist Louis-Nicolas Vauquelin. However, it did not receive its name until 1824, when the French botanist and chemist Henri Braconnot continued his research and named the gelatinous substance pectic acid. One hundred years later, K. Smolenski was the first to suspect that pectin might consist of galacturonic polymeric acid. In 1930, Meyer and Mark recognized the chain shape of the pectin molecule, and in 1937, Schneider and Bock developed a formula for pectin. It was not until the beginning of the twentieth century that people recognized the practical uses of pectins, which would have used their good gelling properties for food production. Probably the best known brand for pectin-containing gelling agents since 1928 was Opekta [16].

By adding pectin, it is desired to reduce the cooking time, which is about 5 minutes so that the values and properties of the fruit are preserved as much as possible and obtaining a food rich in nutrients, fiber, vitamins and minerals.

The use of raw gooseberries, and the addition of pectins in different percentages, led to the obtaining of jams rich in polyphenolic compounds and low in sugar. The results we obtain provide information about the correlations between the content of total polyphenolic compounds and the total antioxidant capacity of the formulated product formulas.

Pectin can be extracted industrially from certain types of fruit for the manufacture of jams and jellies and was first separated in the 1820s. Citrus peels and dried apple substance are often used in the food industry due to their high pectin content. Also, fruits rich in pectin can be mixed with those low in pectin, such as strawberries and red currants, to be transformed into jams and jellies. Because pectin is widely used as a thickening agent in the manufacture of commercial foods

According to a study published in May 2012 in the European Journal of Clinical Nutrition [17], pectin can help keep cholesterol at normal levels. Participants in this study consumed 15 g of apple or citrus pectin daily for four weeks. The results showed that pectin, from any source, lowers LDL, "bad" cholesterol by 7 to 10 percent. In a subsequent trial, the administration of 6 g of citrus pectin per day for three weeks resulted in a 6-7 percent decrease in LDL.

Pectin is a type of viscous dietary fiber. According to a report by the United States Department of Agriculture, viscous fibers lower the glycemic response of food, delaying gastric emptying and, consequently, the absorption of glucose by the body [17].

Classification of pectins. Strongly methylated or highly esterified pectins have a degree of esterification higher than 50% by definition, gel with a sugar content of at least 55% by weight, they need a pH of 1–3.5 for this, therefore, it can only be used in acidic foods with a high sugar content (jams and fruit fillings). Low methylated pectins, low in methyl ester have a degree of esterification between 5% to 40% by definition, may form jelly even without sugar in the presence of polyvalent cations, need a pH value of 1-7 for this, are used for the production of pumpkin fruit preparations, especially for dairy products. are used to make low-calorie fruit canapés [18].

Gelling mechanisms. Pectin molecules are very large (macromolecules) and should be difficult to remove due to their large weight and surface area. In fact, however, relatively large amounts of pectin can be dissolved in just a little warm water. The cause of this phenomenon is the free carboxylic acid groups of the building blocks of galacturonic acid. The acidic groups dissociate in aqueous solution. This creates anionic acid residues that are more or less evenly distributed over the macromolecule. The negative charge ensures that the pectin molecules repel each other electrostatically. In addition, large hydration shells form around these charge carriers, which further prevents the molecules from approaching each other. In this way, the pectins remain in suspension, which is why the pectins are allocated to the group of hydrocolloids. To gel, the barrier of electrostatic repulsion and hydration shells must be overcome [16].

3.2. Exploiting gooseberries to develop innovative biscuit formulations

Biscuits are part of the category of flour products that are obtained by baking a loose dough, with a low humidity, high energy value and a diverse assortment. The dough is obtained by homogenizing ingredients such as flour, fructose, eggs, butter and various flavors.

The chemical composition rich in fats and carbohydrates make biscuits an important source of energy [19].

Fortification of biscuits by adding gooseberries is an affordable technique that allows both increasing the content of polyphenolic compounds and antioxidant capacity and improving the sensory attributes of formulas developed. A special attention will be paid to the impact of conditioning process for the stability of polyphenolic compounds because high temperatures and prolonged exposure to heat treatment lead to their degradation and reduced antioxidant capacity of gooseberries. The degree of depreciation of antioxidant properties increases with increasing temperature and drying time. An advantage of conditioning gooseberries by drying is that in addition to prolonging shelf life due to reduced water content also ensures the stability of bioactive compounds.

Because the trend of buyers is to combine the pleasant taste of biscuits with the health benefits that their consumption can bring.

To meet this need, manufacturers are constantly looking for new ways to capitalize on materials with high nutritional value and high therapeutic effect.

Biscuits have an important place in our diet, the advantage represented by them being that of a long shelf life, a different composition, easily adaptable to nutritional needs, and is an important energy source [19].

Regarding the production of biscuits with the addition of dehydrated gooseberries, the process is a more complex one, which requires more attention and longer preparation time. The washed gooseberries are cut into thin slices, placed on a tray and left at room temperature to dehydrate, for four days. After dehydrating, they are finely chopped, after which they are introduced into the composition obtained by the mixture of butter, fructose, eggs and flour. The resulting dough is stretched, cut into the desired shapes and baked for about 10 minutes at 180°C until it turns golden brown on the outside. The biscuits thus obtained are left to cool, then stored in special metal boxes to protect them from light and moisture. During food processing and storage, their nutritional properties are affected by oxidation processes. Storage conditions such as: exposure to light, temperature and atmosphere, play a key role in inducing oxidative degradation processes. Moreover, the heat processing process can in turn increase oxidative instability due to damage to the physical structure and the release of prooxidant compounds from the intracellular environment [3]. For this reason, the remanence of these properties after a certain storage time will also be studied.

A review of literature data has shown that the manufacture of biscuits represents an attractive way to exploit the bioactive content of gooseberry.

The results expected by capitalizing on gooseberry in this way will provide new information about the impact of the addition of gooseberries in different percentages on the antioxidant and sensory properties of biscuits. Based on the sensory analysis, the maximum level of incorporation of fruits in the biscuit manufacturing recipe will be established. Their inclusion in dehydrated form will lead to innovative biscuit formulas with improved antioxidant properties, without depreciating the sensory characteristics. Following the laboratory analyzes, it is desired to ascertain the way of improving the content of total anthocyanins in the different assortments of biscuits.

Also, the addition of dehydrated gooseberries in the recipe for obtaining biscuits, improves in a pleasant way the sensory characteristics of the product having the advantage that it helps to diversify the assortment. Given that gooseberries are local fruits available in large quantities, it is recommended to use them in a dehydrated state in the food industry, to obtain foods with improved nutritional value.

4. Conclusions

A potential impact of exploiting fruit with a high level of bioactive compounds is definitely the economic one. By using local fruits, the costs of purchasing the raw material are reduced and the profit from the placing on the market of the new developed products is significant. The topic is part of the latest concerns existing internationally because the rational processing of fruits grown in our country, offers the opportunity to obtain high value-added products with applications in the food industry. Studies lead to the proposal of directions for capitalizing on gooseberries by incorporating them in dehydrated form and in different proportions in the recipe for making biscuits, but also by capitalizing on them in the form low sugar jam, with the addition of different proportions of pectins. Gooseberries are the most handy fruits with a high content of bioactive compounds, suitable for addition to various pastries, such as biscuits, which are part of the category of sugary pastries, the easiest to innovate because their base allows a multitude of additives.

Compliance with Ethics Requirements: Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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