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DEVELOPMENT AND CHARACTERIZATION OF A BIOLOGICALLY ACTIVE WHITE SAUCE BASED ON HORSERADISH, ONION, PARSLEY AND PARSNIP

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Abstract: Horseradish (*Armoracia rusticana* L.), onion (*Allium cepa*), parsley (*Petroselinum crispum*) and parsnip (*Pastinaca sativa* L.) are a rich source of biologically active compounds with multiple therapeutic effects. The aim of the paper was to obtain a functional product - a white sauce rich in biologically active principles with high availability for the human body, based on horseradish, onion parsley and pastry. In order to obtain a product that could be used as a dressing for food industry, a classical technological process was used, resulting in a nutritionally complex product with multiple therapeutic effects. Physicochemical methods have been used to determine moisture, acidity and mineral substances. In addition, total phenolic and antioxidant activity were assessed using the Folin Ciocalteau and DPPH methods, respectively.

Keywords: White sauce, Horseradish, Onion, Parsnip, Parsley

Introduction

Vegetable is a source of essential nutrients such as vitamins and minerals and it is important source of potent natural antioxidants. Antioxidants differ greatlyinbiological properties and chemical structure; they are used for preventing and treating oxidative stress-related diseases,being potential agents (Mitic *et al.*,2014).

Consumption of fruits and vegetables is associated with a reduced risk for the development of chronic diseases(e.g., cardiovascular disease, cancer, etc.), as revealed by epidemiological studies (Yang, *et al.*,2004).

Horseradish (*Armoracia rusticana L.*) is part of the family *Brassicaceae*, being cultivated for its root for over 2000 years. It is a perennial

plant which shows a particularly pungent flavour and significant antioxidant properties. Horseradish is indigenous to Eastern and Northern Europe and the Mediterranean and is also cultivated in Central Europe. The root of horseradish has a fleshy white interiorand a brown outer peel. The root by itself does not give much aroma, but releases a pungent, burning, mustard-like aroma when grated, cutted or shredded; however, it disappears very quickly (Tomsone *et al.*,2013).

Horseradish is rich in glucosinolates that provide the characteristic flavor and aroma as a result of their breakdown into isothiocyanates and others sulfur compounds. Horseradish, represents a rich source of health-promoting phytochemicals, and their beneficial effects have been principally attributed to the anticancer properties of glucosinolates and their isothiocyanates derivatives and vitamins. Also, horseradish contains the complex mixture of phenolic compounds possessing antioxidant activity (Calabrone *et al.*,2015).

Due to the characteristic pungent, intensive lachrymatory odor and taste of the root, horseradish is cultivated mostly for condiment production. It is also used as a type of food and for traditional medical purposes. For example, horseradish has been used to ease pain such as low back pain and pain associated with sciatica and rheumatism. It is also traditionally used as a urinary, gastrointestinal, and respiratory aid, for toothache, and as aphrodisiac.

Combination of horseradish root and honey in warm water is made for treating influenza. However, the underlying mechanism of possible medicinal benefits of horseradish remains unclear (Sampliner *et al.,* 2009).

Horseradish was described by the abbess Hildegard from Bingen, Germany, as a medicinal plant in the 12th century. She mentioned horseradish as a treatment for lung and heart diseases (Bladh *et al.,* 2014)Some of the uses mentioned in the literature include that horseradish can heal wounds, that it is good for fever and pain, relieves headaches, is good for high blood pressure and gout, and helps against digestive problems. It was also used for treating urinary tract infections and bronchitis and its bactericidal properties (Bladh *et al*., 2011).

Allium species (one of the most important genus of the *Alliaceae* family) are among the oldest cultivated vegetables, being used as spices, vegetables, ornamentals, or as medicines for curing various diseases (Tepe *et al.,* 2005). *Allium* species are rich in sulfur compounds, which are responsible for the organoleptic parameters and contribute to the antioxidant and antimicrobial activities of these vegetables (Mnayer *et al.,* 2014).

Onion (*Allium cepa*) is part of *Allium* species, being consumed all over the world.Onion nutritional composition is very complex. Onion bulbs (*Allium cepa* L.) are rich in dietary flavonoids and contribute to a large extent to the overall intake of flavonoids (Slimestad *et al.*, 2007).Specifically, onion has been characterized for its flavonol quercetin and quercetin derivates. Moreover, it is rich in bioactive compounds such as frutooligosaccharides and sulfur compounds. Phytochemicals, including phenols and flavonoids, specifically, onion has been characterized for its flavonol quercetin and quercetin derivates are suggested to be the major bioactive compounds contributing to the health benefits (Eduvigis *et al.*, 2008).Sulfur compounds from onions are responsible for typical odour and flavour and are also active antimicrobial agents hence, onions may be used as natural preservatives to control microbial growth (Liguori *et al.*, 2017).

Parsnip (*Pastinaca sativa L*.) colonizes habitats in temperate regions, beinga biennial plant. It is found predominantly nearthe roads, or streams, in forests and meadows (Tokarska-Guzik *et al.*, 2012). The edible taproot might be white, gray, yellow or brown-yellow. Parsnips have three times the nutritional value of carrots, being a rich source of vitamins (C, B1, B2, E, PP), caroteneand minerals (potassium, calcium, phosphorus and iron).Parsnips are also recommended for people suffering from atherosclerosis,obesity, and cardiovascular diseases. It contains aromatic essential oils in all plant parts; parsnips can be consumed on their own or in combination with other food products (Kaliniewicz *et al.*, 2014).

The species of *Petroselinum crispum* belongs to the family *Apiaceae*, popularly known as parsley. Parsley stands out because it is one of the most consumed herbs in the world. It can be utilized either in the food industry or as medicinal plant. It is ussually consumed fresh or dehydrated, and in that case, the most consumed parts are leaves, petioles and seeds. The chemical composition of parsley essential oil consists of pinned, myrcene, phellandrene, cymene, methatriene, elemene, myristicin and apiole (Petropoulos *et al.*, 2008).They can substitute or act in synergism with chemical compounds, mainly the synthetic ones, since they have antimicrobial potential besides having immomodulating function, antioxidant and food preservative properties. It is used in traditional medicine as a digestive, colic, for relief of bladder inflammation and to treat kidney diseases, increase lactation, resume menstruation, dental pains and for treatment of skin diseases. Earlier studies demonstrated that parsley shows pharmacological activities, being hepatoprotective, anti-diabetic, analgesic, spasmolytic, immunosuppressant, anti-platelet, gastroprotective, laxative,

estrogenic, diuretic, antihyperlipidemic, hypoglycemic activity, antioxidant, and anti-inflammatory properties (Hussein *et al.*, 2016).

Consequently, the aim of this paper is to develop and characterize a functional food product based on horseradish, onion, parsley and parsnip– a white sauce – which is rich in biological active compounds, and shows multiple health benefits.

Materials and methods

Horseradish (17% m/m), onion (26% m/m), parsley (20% m/m) and parsnip (24% m/m) were used as main raw materials for obtaining the sauce while pepper(0.6% m/m), salt (0.8% m/m), sugar (4% m/m), oil (1.6% m/v), vinegar (2% m/v) and lemon (4% m/v) were considered auxiliary raw materials. The technological flow used to obtain the white sauce rich in active biological principles is shown in Fig. 1. The ingredients used are a source of potentially high antioxidant compounds, vitamins, minerals, all of them with proven benefits for the human body

The total phenolic assay

Total polyphenol content of sauce and horseradish was determined according to the method described by (Mureşan *et al.* 2016; Semeniuc *et al.* 2016). An aliquot of 25µL sample was transferred into a glass test tube. Then, 1.8 mL of distilled water and 120 µL of Folin–Ciocalteu phenol reagent were added. After 5 min, 340 µL of sodium carbonate aqueous solution (7.5%, w/v) was added to the mixture. After incubation for 90 min at room temperature, in dark, the absorbance was read at 750 nm, using a Shimadzu UV-1700 Pharma Spec spectrophotometer, against the blank, in which the sample was replaced with methanol. Standard curve was performed using different concentration solution of Gallic acid and the results were expressed as mg of GAE/100 g sample.

Antioxidant capacity assessment by DPPH method

The antioxidant activity was determined using the 2.2- diphenyl-1-picrylhydrazyl (DPPH) method according to (Mureşan *et al.*, 2014; Odriozola-Serrano *et al.* 2008). An amount of 30µl of the methanol extract was transferred into a glass test tube with a screw cap, then 270 µL of distilled water and 11.7 mL of DPPH solution in methanol (0.025 g/l) were added. The incubation of the test sample was carried out in dark, at room

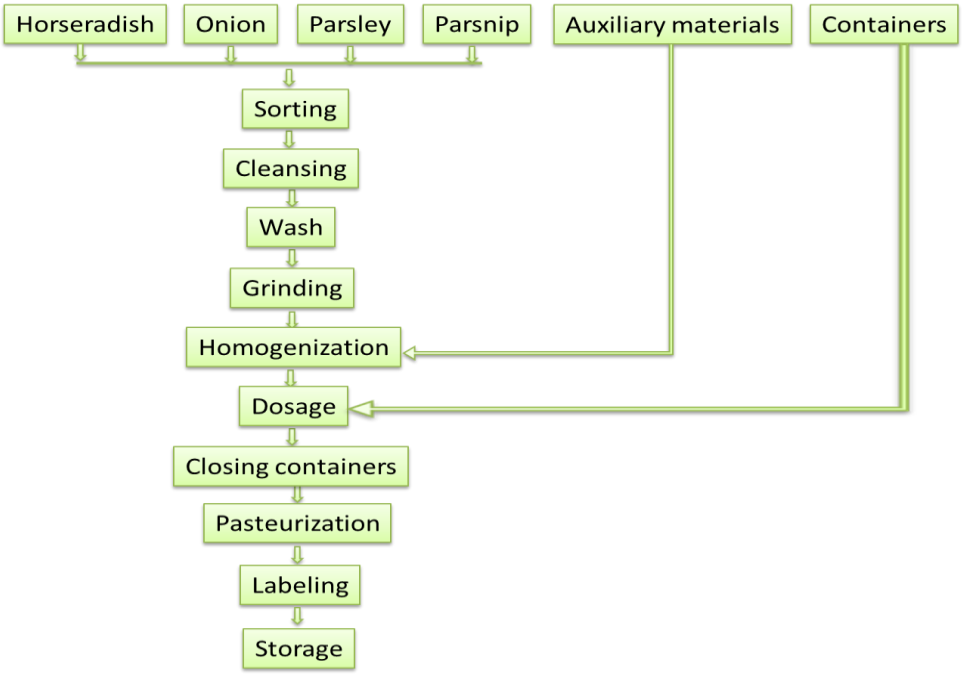

Fig. 1. Technological flow for obtaining white sauce rich in biologically active principles at laboratory scale

temperature for 30 min. The absorbance value was read at 515 nm against methanol with a double-beam UV-VIS spectrophotometer (Shimadzu 1700 UV-VIS). The positive control was prepared using a gallic acid solution (0.5 mg/mL). The negative control was prepared using methanol. Results were expressed as percent over standard DPPH absorbance according to Eq.(1).

$$RSA[\%] = \frac{A_{DPPH} - A_P}{A_{DPPH}} \times 100 \quad \text{Eq.(1)}$$

where, DPPH is the absorbance of DPPH free radical in methanol and Ap – sample is the absorbance of DPPH free radical solution mixed with the sample.

Total acidity

The total acidity was performed by neutralization with sodium hydroxide solution (0.1 N) in the presence of methylene blue as indicator Eq.(2).

Total acidity = m x 0,0067 x 2 x V g % acid malic Eq.(2).

where: m - the weight of the sample , V– volume of NaOH 0.1N used for titration; 0.0067 conversion factor: 1 ml 0.1 N sodium hydroxide corresponds to 0.0067 g malic acid

Ash Determination

The content of mineral substances was assessed by calcination at 550-600°C Eq.(3).

$$\text{Ash} = \frac{G_1}{m} \text{ x } 100 \text{ (g \% ash)} \qquad \text{Eq.(3).}$$

where: m – the amount of the sample under analysis [g]; G_1 – the amount of ash after calcination [g]; (Tofană and Mureşan, 2012, STAS 6182/3-70).

Moisture Determination

Moisture content was determined by drying in an oven at 103^o C ± 2^o C for 3 hours, the experiment being repeated until the weight was constant. The samples were cooled in a desiccator for one hour and weighed (AOAC, 1999)

Results and discussion

Currently, consumer awareness and interest for nutritional qualityis observed in many societies, being especially focussed for healthy food. They try to choose products with not only desired taste, but also those that may have a particularly positive impact on their health. White sauce can be considered a food with multiple effects therapies due to the mix of vegetables used.

Moisture is an important parameter for the quality and stability of white sauce, because high moisture content can lead to the alteration and instability of the sauce, hence it has to be at low levels, but suficient enough for showing the desired viscosity. As can be seen, the moisture content of the white sauce is 24.29% making this product stable, as well as showing the desired rheological properties.

Vegetables are a rich source of minerals and trace elements essential for the functioning of the body. The sauce has a content of 0.378 % mineral substances derived from the ingredients used, ingredients known as a rich source of minerals.

The acidity represents a quality element that is part of white sauce quality. To keep balance acidity in the body, one must consume 4 times more alkaline foods than acidic. As can be seen the white sauce has a low acid vegetables because it is made alkaline healthy human body.

Table 1

The moisture, ash content and total acidity of the white sauce sample

Samples	Moisture %	Ash Content, %	Total acidity, g % malic acid
Sauce white	24.29± 0.15	0.378 ±0.04	0.191± 0.03

Table 2

Total polyphenols and antioxidant capacity of sauce white

Samples	Total polyphenols, Mg GAE/100g	Antioxidant capacity [%]
Sauce white	151.06 ± 0.31	20.16 ± 0.04

The total phenol content in the investigated samples of white sauce extracts was determined by Folin – Ciocalteu method as shown in Table 2.The experimental results showed that the content of total phenols in the investigated extracts was significant, the amount of polyphenols in the white sauce was de 151.06 mg GAE/100g, this value being a sum of the phenolic compounds of horseradish, onion, parsley and parsnip.

The DPPH radical has been commonly used to evaluate the free radical scavenging activities of compounds. The radical scavenging activity of extracts obtained from white sauce, was tested by DPPH method and the results are showed in Table 2.Tested extracts exhibited strong scavenging activity against DPPH radicals, totalizing an average of 20.16%.

Conclusions

The complex chemical composition, its antioxidant capacity and the content of biologically active compounds in the examined white sauce sample, successfully recommended it for industrial production and consumption.

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