Chapter 4

Pale-Green Kohlrabi, a Versatile *Brassica* Vegetable

Ana-Alexandra Sorescu, Alexandrina Nuta and Rodica-Mariana Ion

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.76921

Abstract

This chapter describes recent research studies about kohlrabi, a versatile vegetable with important health benefits (e.g. reduces risk of breast and prostate cancer, improves body metabolism, helps in weight loss diets, etc.). The investigations are focused on pale-green kohlrabi giving an accurate and precise description, from a qualitative point of view, of the bioactive compounds found in different parts of the pale-green kohlrabi: core, peel, leaves and equal combinations between these parts. All the active principles from pale-green kohlrabi are extracted following a well-established method, in an aqueous medium at a constant temperature of 4°C for 24 h. The qualitative screening of phytochemicals gives details regarding the presence or absence of chemical compounds using different colour reactions.

Keywords: *Brassica oleracea*, kohlrabi, aqueous extracts, bioactive compounds, qualitative screening

1. Introduction

Brassica vegetables, also known as 'cruciferous vegetables', consist of a large group of herbaceous plants that include some of the world's most cultivated vegetables, namely cabbage, broccoli and cauliflower. Besides their main use as food ingredients, *Brassica* vegetables are full of antioxidants that help lower the potential risk of different types of cancers and coronary heart issues and are an important source of vitamin C, folic acid and numerous minerals such as iron, potassium and selenium [1].

Brassicas are also renowned for containing disease-fighting compounds, phytochemicals that occur naturally in plants and exhibit a variety of health benefits for the human body. One

of those biologically active compounds is glucosinolates, sulphur-containing phytochemicals with strong anti-cancer properties [2–4]. *Brassica* vegetables contain significant amounts of carotenoids such as zeaxanthin and lutein, two important components of the macula lutea region of the retina, and, therefore, play an important role in the prevention of age-related macular degeneration [5].

Kohlrabi (*Brassica oleracea* of the Gongylodes group) is one of the top vitamin C plants (one cup of kohlrabi contains more than 100% of the daily dose recommended for human consumption). It has European origins, being often called 'German turnip', with a sweet and delicate taste, rather a combination between radish and cabbage.

Kohlrabi is a bulbous vegetable available all year round and can be eaten either raw or cooked; both root and leaves are recommended in human consumption as they contain significant amounts of nutrients and are poor in calories [6, 7].

Several varieties of kohlrabi are commonly grown and commercially available, including White Vienna, Purple Vienna, Grand Duke, Gigante, Purple Danube and White Danube.

The main benefits in human health of kohlrabi are presented in **Figure 1**.

In the present chapter, different parts (e.g. core, peel and leaves) of pale-green kohlrabi are used to prepare five distinct aqueous extracts that are analysed by means of qualitative phytochemical content [8–10].

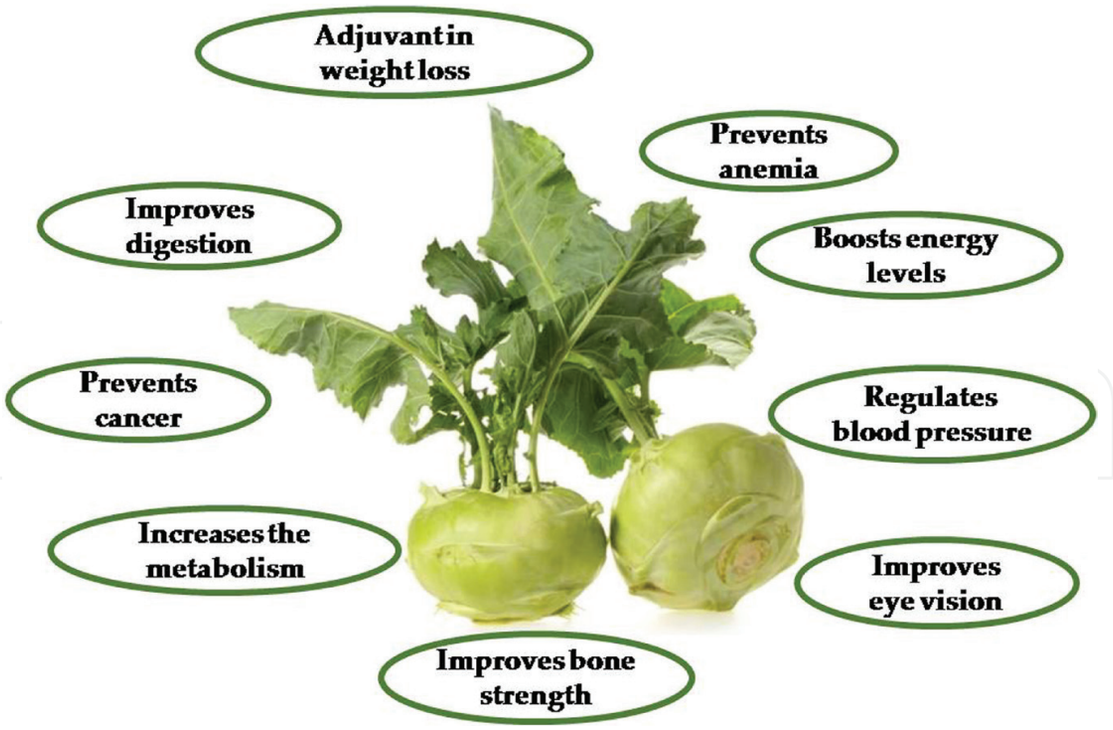

Figure 1. Health benefits of pale green kohlrabi.

2. Preparation of aqueous extracts from pale-green kohlrabi

Five distinct aqueous extracts are prepared from different parts of pale-green kohlrabi, as follows:

- three simple aqueous extracts from only one part, for example, core, peel and leaves; and
- two combined aqueous extracts from core and peel in equal parts, respectively core, peel and leaves in equal amounts.

The main steps involved in the preparation of aqueous extracts from pale-green kohlrabi are (**Figure 2**) acquiring pale-green kohlrabi from the local market, thoroughly washing it with tap water once and distilled water thrice, separating the component parts (core, peel, leaves), shade-drying it at room temperature, grinding the components into fine parts, extracting a determined quantity of the dried powder in an aqueous medium for 24 h and filtering the resulting extract until no debris are present in the aqueous extract.

All five distinct pale-green kohlrabi aqueous extracts are prepared according to the same method that was generally described above; the only difference is the amount of dried plant that resulted after the extraction and the volume of the resulting aqueous extract. In **Table 1** the amount of dried plant material before and after the extraction is presented, and **Table 2** contains the exact volume of different resulting aqueous extracts compared to the initial volume of distilled water.

The extractive value (yield percentage) of the kohlrabi (peel, core, leaves, equal amounts of peel and core, equal amounts of peel, core and leaves) samples was calculated before and after

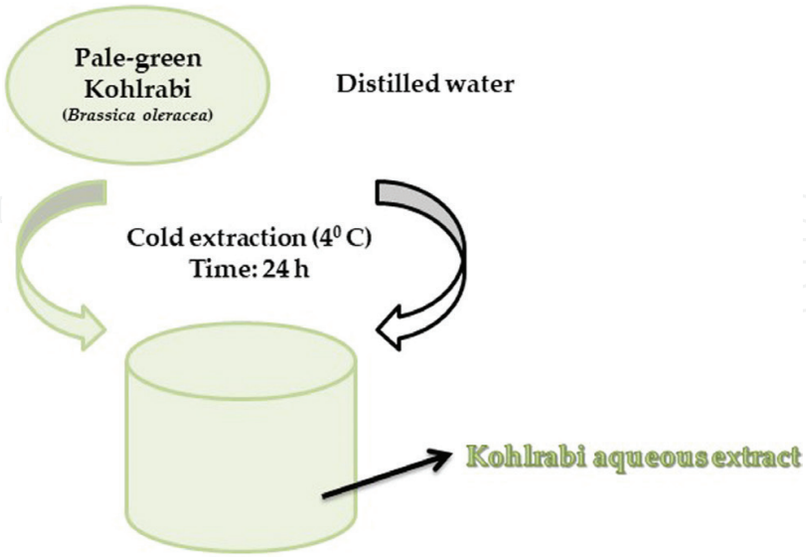

Figure 2. General method for preparation of aqueous extract from pale-green kohlrabi.

Crt. No.	Aqueous extract	Weight before extraction (g)	Weight after extraction (g)	Yield (%)
1	Pale-green kohlrabi core	25	19.06	76.24
2	Pale-green kohlrabi peel	25	21.26	85.04
3	Pale-green kohlrabi leaves	25	20.64	82.56
4	Pale-green kohlrabi core and peel (equal amounts)	25 (12.5 g core + 12.5 g peel)	17.63	70.52
5	Pale-green kohlrabi core, peel and leaves (equal amounts)	30 (10 g core + 10 g peel + 10 g leaves)	22.85	76.17

Table 1. Quantities of solid vegetal material before and after the extraction.

Crt. No.	Aqueous extract	Distilled water (mL)	Volume of aqueous extract (mL)
1	Pale-green kohlrabi core	250	202
2	Pale-green kohlrabi peel	250	170
3	Pale-green kohlrabi leaves	250	192
4	Pale-green kohlrabi core and peel	250	190
5	Pale-green kohlrabi core, peel and leaves	300	208

Table 2. Volume of resulted aqueous extracts from pale green kohlrabi.

the preparation of the aqueous extracts using the formula and the results are also presented in **Table 1** [11]:

$$\text{Extract yield \%} = \left[W_1/W_2\right] \times 100.$$

where W_1 = net powder weight (grams) after extraction and W_2 = total powder weight (grams) used for the preparation of aqueous extracts.

3. Qualitative screening of phytochemicals from pale-green kohlrabi aqueous extracts

Various standard qualitative phytochemical analyses are known that allow the determination of chemical groups or compounds in aqueous extracts from different plants. The majority of these qualitative tests is based on the change of colour or precipitation as a clear response to the presence of that specific chemical compound [12, 13]. It is important to mention that these colour reactions allow only to highlight the presence or absence of various chemical groups and not the amount in which they are present in different aqueous extracts.

Standard phytochemical methods are used to analyse from a qualitative point of view all the five aqueous extracts prepared as mentioned in the previous section [14, 15].

3.1. Qualitative screening of carbohydrates

Carbohydrates, the sugars and fibres that can be found in every fruit or vegetable, represent one the basic food groups of great importance for human health. Carbohydrates are among the top three macronutrients, along with protein and fats.

A large number of analytical techniques have been used to determine the concentration and different types of carbohydrates found in foods.

There are four different standard phytochemical methods used for the qualitative screening of carbohydrates found in aqueous extracts [16] (**Table 3**):

a. A 1 ml Molisch reagent (a solution of α-naphthol in ethylic alcohol) is added to 2 ml aqueous extract to which few drops of concentrated sulphuric acid are slowly dripped until a purple-reddish colour appears;

b. To 1 ml of aqueous extract, 5 ml of Benedict's reagent (a complex solution of sodium carbonate, sodium citrate and copper sulphate pentahydrate) was added and boiled for 5 min. The bluish-green colour indicates the presence of carbohydrates;

c. To 1 ml of aqueous extract, few drops of Fehling A reagent (aqueous solution of copper sulphate) are added, which gives green colouration;

d. To 1 ml of aqueous extract, few drops of Fehling B reagent (a solution of potassium sodium tartrate in sodium hydroxide) are added, and a brown colour appears.

It is clear from the colour reaction described above that, with the only exception of pale-green kohlrabi peel, carbohydrates can be found in all the other four aqueous extracts.

3.2. Qualitative screening of tannins and phlobatannins

Tannins are a group of phenol compounds usually found in plants, part of a group of chemicals called 'polyphenols', and almost all of them are soluble in water. Phlobatannins are largely considered a novel class of ring-isomerized condensed tannins [17].

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Carbohydrates—Molisch	Purple solution	Yellow-mustard solution	Purple solution	Purple solution	Purple solution
Carbohydrates—Benedict	Blue-green solution	Turquoise solution	Blue-green solution	Blue-green solution	Blue-green solution
Carbohydrates—Fehling A	Green solution	Turquoise opalescent solution	Green solution	Green solution	Green solution
Carbohydrates—Fehling B	Brown solution	Citron-yellow solution	Brown solution	Brown solution	Brown solution

Table 3. Qualitative screening of carbohydrates.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Tannins	Brown-yellow opalescent solution	Yellow-brown solution	Brown-yellow solution	Brown solution	Brown solution
Phlobatannins	Red-brown opalescent solution	White opalescent solution	Red-brown opalescent solution	Red-brown solution	Yellow solution

Table 4. Qualitative screening of tannins and phlobatannins.

According to the literature [18], the test for tannins consists of the following steps: to 1 ml of aqueous extract 2 ml of 5% ferric chloride is added and a dark blue or greenish black colour appears.

Phlobatannins are tested as follows: To 1 ml of aqueous extract few drops of diluted HCl (1%) are added and a red precipitate appears (**Table 4**).

Tannins are absent from all the five pale-green kohlrabi aqueous extracts while small traces of phlobatannins can be found in three aqueous extracts: pale-green kohlrabi core, pale green kohlrabi leaves and in the aqueous extract prepared from equal amounts of core and peel.

3.3. Qualitative screening of saponins

The general method is 2 ml of aqueous extract and 2 ml of distilled water are shaken in a graduated cylinder for 15 min. A 1 cm foam layer indicates the presence of saponins (see **Table 5**).

3.4. Qualitative screening of flavonoids and phenolic flavonoids

Flavonoids are a class of polyphenolic compounds with important functions in plants: attract pollinating insects, fight against different microbial infections and control cell growth [19].

Flavonoids are tested as follows: 2 ml of aqueous extract and 1 ml of 2 N sodium hydroxide are mixed. A yellow colour indicates the presence of flavonoids. The test for phenolic flavonoids involves the reaction between 1 ml of aqueous extract and 2 ml of 10% lead acetate solution reacting to give a brown precipitate (see **Table 6**).

Flavonoids are present in two aqueous extracts (pale-green kohlrabi peel and pale-green kohlrabi leaves), while phenolic flavonoids occur in pale-green kohlrabi core and in the two complex aqueous extracts that contain it.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Saponins	2 cm foam layer	3 cm foam layer	2.5 cm foam layer	3.5 cm foam layer	3 cm foam layer

Table 5. Qualitative screening of saponins.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Flavonoids	Red-brown solution	Pale-yellow solution	Pale-yellow opalescent solution	Red-brown solution	Brown solution
Phenolic flavonoids	Brown precipitate	White precipitate	Pale-yellow precipitate	Pale-brown solution	Opalescent brown-yellow solution

Table 6. Qualitative screening of flavonoids and phenolic flavonoids.

3.5. Qualitative screening of alkaloids

Alkaloids are naturally occurring compounds that contain basic nitrogen atoms. They have a large variety of pharmacological applications: antimalaria, antiasthma, anticancer, analgesic, and so on [20].

There are two different standard phytochemical methods:

a. To 1 ml of aqueous extract, 1 ml of Wagner's reagent (iodine in potassium iodide solution) is added leading to the formation of a reddish brown precipitate.

b. To 1 ml of aqueous extract, 2 ml of concentrated hydrochloric acid and a few drops of Mayer reagent are added, resulting in a green colour or white precipitate (the results are presented in **Table 7**).

According to the results presented in **Table 7**, alkaloids are absent from all the aqueous extracts from pale-green kohlrabi, whatever method was used for the qualitative screening.

3.6. Qualitative screening of anthraquinones and anthocyanosides

The standard method used for the qualitative screening of anthraquinones involves the reaction of 1 ml of aqueous extract with a few drops of 10% ammonia solution, leading to the formation of a pink precipitate. Anthocyanosides are observed when 1 ml of aqueous extract is mixed with 5 ml of dilute hydrochloric acid and a pink colour appears (see **Table 8** for the results).

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Alkaloids—Wagner	Opalescent red-brown solution	Opalescent brown solution	Opalescent yellow-brown solution	Clear red-brown solution	Opalescent red-brown solution
Alkaloids—Mayer	Opalescent orange-yellow solution	Opalescent beige solution	Brown-yellow opalescent solution	Red-brown solution	Opalescent beige solution

Table 7. Qualitative screening of alkaloids.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Anthraquinones	Red-beige solution	Pale-yellow opalescent solution	Green-yellow precipitate	Opalescent red-brown solution	Opalescent red-beige solution
Anthocyanosides	Red-yellow opalescent solution	Yellow opalescent solution	Pale-pink opalescent solution	Orange-red solution	Pale-beige solution

Table 8. Qualitative screening of anthraquinones and anthocyanosides.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Proteins and aminoacids—Millon	Red-beige solution	Opalescent White solution, pale-yellow after heating	Opalescent beige solution, brown after heating	White brown solution, beige-red after heating	Opalescent beige solution, red-brown after heating
Proteins and aminoacids—Biuret test	Red-yellow opalescent solution	Opalescent blue solution	Green-yellow solution, blue precipitate	Dark-brown solution	Violet-green solution

Table 9. Qualitative screening of proteins and aminoacids.

3.7. Qualitative screening of proteins and aminoacids

There are two different standard methods used (see results in **Table 9**):

a. 1 ml of aqueous extract reacts with 5–6 drops of Millon's reagent, and a white precipitate appears that changes its colour to red upon heating;

b. To 3 ml of aqueous extract, 3 ml of 4% sodium hydroxide solution and few drops of 1% copper sulphate are added to form a purple solution.

3.8. Qualitative screening of steroids and terpenoids

The general procedure to test the presence of steroids is To 1 ml of aqueous extract, add 10 ml of chloroform and slowly drip 10 ml of sulphuric acid. The upper layer turns red and the sulphuric acid layer turns yellow green. Similarly, terpenoids are analysed by reacting 1 ml of aqueous extract with 2 ml of chloroform and then slowly few drops of concentrated sulphuric acid. An interface with a reddish brown colouration appears (**Table 10**).

The qualitative screening of steroids revealed that these phytochemicals are absent from all the extracts while very small traces of terpenoids could be visually observed in three aqueous extracts: pale-green kohlrabi core and the other two extracts that contain this part.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Steroids	Colourless layer, brown ring, colourless layer	Colourless layer, beige ring, colourless layer	Colourless layer, light-brown ring, colourless layer, brown ring	Colourless layer, brown ring, colourless layer	Colourless layer, brown ring, colourless layer
Terpenoids	Colourless layer, yellow-brown ring	Colourless layer, white ring (precipitate)	Pale-yellow layer, beige ring	Yellow-brown layer, red-brown ring	Colourless layer, brown-yellow opalescent ring

Table 10. Qualitative screening of steroids and terpenoids.

3.9. Qualitative screening of cardiac glycosides

There are two different standard phytochemical methods:

a. 1 ml of aqueous extract, 1 ml of $FeCl_3$ reagent (1 ml of 5% $FeCl_3$ solution mixed with 99 ml of glacial acetic acid) and few drops of concentrated H_2SO_4 gives a greenish-blue colour that appears in time;

b. 5 ml of aqueous extract, 2 ml of glacial acetic acid, a drop of $FeCl_3$ solution and 1 ml of concentrated H_2SO_4 forms a brown ring and often a purple ring appears below (see results in **Table 11**).

Regardless of the method used in the screening, cardiac glycosides are absent from all the aqueous extracts prepared from pale-green kohlrabi.

Phytochemical test	Pale-green kohlrabi core	Pale-green kohlrabi peel	Pale-green kohlrabi leaves	Pale-green kohlrabi core and peel	Pale-green kohlrabi core, peel and leaves
Cardiac glycosides—$FeCl_3$ reagent	Colourless layer, thin brown ring, beige clear solution	Colourless clear layer, yellow suspension	Colourless layer, pink-beige suspension	Colourless layer, brown ring, opalescent beige layer	Colourless layer, opalescent yellow-beige ring
Cardiac glycosides—Keller-Killani test	Colourless layer, brown ring, beige opalescent layer, red opalescent layer	Colourless layer, red-beige opalescent solution	Colourless layer, yellow-brown layer, brown-red layer	Colourless layer, brown ring, red-brown layer, beige precipitate layer	Colourless layer, brown ring, red-brown layer

Table 11. Qualitative screening of cardiac glycosides.

4. Conclusions

This chapter describes the qualitative phytochemical screening of five distinct aqueous extracts prepared from different parts of pale-green kohlrabi, a versatile vegetable part of *Brassica*

genus with numerous benefits for human health. The qualitative screening is achieved by standard methods that are able to determine whether a phytochemical is present or not in a specific aqueous extract.

The qualitative screening of carbohydrates revealed that, except for pale-green kohlrabi peel aqueous extract, in all the other extracts carbohydrates are present. It can be clearly stated that tannins are absent from all the five pale-green kohlrabi aqueous extracts. Phlobatannins can be found, in small traces, in three aqueous extracts: pale-green kohlrabi core, pale-green kohlrabi leaves and in the aqueous extract prepared from equal amounts of core and peel.

In smaller or larger quantities, saponins are present in all five aqueous extracts, according to the height of the resulting foam layer, while alkaloids, cardiac glycosides and steroids are clearly absent from all the extracts.

Acknowledgements

This paper received the financial support of the projects: PN 120BG/2016 and PN 18.22.04.01.01.

Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

Author details

Ana-Alexandra Sorescu[1,2]*, Alexandrina Nuta[1,3] and Rodica-Mariana Ion[1,2]

*Address all correspondence to: anaalexandrasorescu@yahoo.com

1 The National Research and Development Institute for Chemistry and Petrochemistry—ICECHIM, Evaluation and Conservation of Cultural Heritage, Bucharest, Romania

2 Valahia University, Materials Engineering Doctoral School, Targoviste, Romania

3 The Romanian Academy, "Stefan S. Nicolau" Institute of Virology, Bucharest, Romania

References

[1] Martinez-Espla A, Zapata PJ, Castillo S, Guillen F, Martinez-Romero F, Valero D, Serrano M. Preharvest application of methyl jasmonate (MeJA) in two plum cultivars. 1. Improvement of fruit growth and quality attributes at harvest. Postharvest Biology and Technology. 2014;**98**:98-105

[2] Macleod G, Macleod AJ. The glucosinolates and aroma volatiles of green kohlrabi. Phytochemistry. 1990;**29**:1183-1187. DOI: 10.1016/0031-9422(90)85425-F

[3] Wiebe HJ, Habegger R, Liebig HP. Quantification of vernalization and devernalization effects for kohlrabi (*Brassica oleracea* convar. Acephala var. gongylodes L.). Scientia Horticulturae. 1992;**50**:11-20. DOI: 10.1016/S0304-4238(05)80004-4

[4] Escalona VH, Aguayo E, Artes F. Metabolic activity and quality changes of whole and fresh-cut kohlrabi (*Brassica oleracea* L. *gongylodes* group) stored under controlled atmosphere. Postharvest Biology and Technology. 2006;**41**:181-190. DOI: 10.1016/j.postharvbio.2006.04.001

[5] Thomas RA, Krishnakumari S. Phytochemical profiling of *Myristica fragrans* seed extract with different organic solvents. Journal of Pharmaceutical and Clinical Research. 2015;**1**:304-307

[6] Caroling G, Vinodhini E, Mercy Ranjitham A, Shanti P. Biosynthesis of copper nanoparticles using *Phyllanthus embilica* (gooseberry) extract—Characterisation and study of antimicrobial effects. International Jorunal of Nanomaterials and Chemistry. 2015;**1**:53-63

[7] Veerachari U, Bopaiah AK. Preliminary phyto-chemical evaluation of the leaf extract of five *Cassia* Species. Journal of Chemical and Pharmaceutical Research. 2011;**5**:574-583

[8] Periannan U, Pragakaran G. Studies on antibacterial activity and preliminary phytochemical analysisof *Aegle marmelos* L. (Beal). International Journal of Current Sciences and Technology. 2013;**2**:17-20

[9] Subhash CM, Vivekananda M. Essentials of Botanical Extractions. Principles and Applications. 1st ed. San Diego, United States: Elsevier Science Publishing Co Inc. 2015;173-185. DOI: 10.1016/B978-0-12-802325-9.00009-4

[10] Escalona VH, Aguayo E, Artes F. Modified atmosphere packaging improved quality of kohlrabi stems. LWT-Food Science and Technology. 2007;**40**(3):397-403. DOI: 10.1016/j.lwt.2006.02.006

[11] Gong R, Zhang X, Liu H, Sun Y, Liu B. Uptake of cationic dyes from aqueous solution by biosorption onto granular kohlrabi peel. Bioresource Technology. 2007;**98**(6):1319-1323. DOI: 10.1016/j.biortech.2006.04.034

[12] Fahey JW. Reference Module in Food Science. Encyclopedia of Food and Health. 1st ed. Kidlington, Oxford: Elsevier Ltd; 2016. 469 p. DOI: 10.1016/B978-0-12-384947-2.00083-0

[13] Choi S, Beuchat LR, Kim H, Ryu JH. Viability of sprout seeds as affected by treatment with aqueous chlorine dioxide and dry heat, and reduction of *Escherichia coli* O157:H7 and *Salmonella enterica* on pak choi seeds by sequential treatment with chlorine dioxide, drying and dry heat. Food Microbiology. 2016;**54**:127-132. DOI: 10.1016/j.fm.2015.10.007

[14] Kosewski G, Gorna I, Boleslawska I, Kowalowka M, Wieckowska B, Glowska AK, Morawska A, Jakubowski K, Dobrzynska M, Miszczuk P, Przyslawski J. Comparison of antioxidative properties of raw vegetables and thermally processed ones using the conventional and sous-vide methods. Food Chemistry. 2018;**240**:1092-1096. DOI: 10.1016/j.foodchem.2017.08.048

[15] Muhamad II, Hassan ND, Mamat SNH, Nawi NM, Rashid WA, Tan NA. Extraction technologies and solvents of phytocompounds from plant materials: Physicochemical characterization and identification of ingredients and bioactive compounds from plant extracts using various instrumentation. Ingredients Extraction by Physicochemical Methods in Food. Handbook of Food Bioengineering. 1st ed. London: Elsevier Ltd. 2017. 523 p. DOI: 10.1016/B978-0-12-811521-3.00014-4

[16] Picariello L, Gambuti A, Picariello B, Moio L. Evolution of pigments, tannins and acetaldehyde during forced oxidation of red wine: Effects of tannins addition. LWT. 2017;**77**:370-375. DOI: 10.1016/j.lwt.2016.11.064

[17] Steenkamp JA, Steynberg JP, Brandt EV, Roux DV. Phlobatannins, a novel class of ring-isomerized condensed tannins. Journal of the Chemical Society, Chemical Communications. 1985. DOI: 10.1039/c39850001678

[18] Loman AA, Ju LK. Enzyme-based processing of soybean carbohydrate: Recent developments and future prospects. Enzyme and Microbial Technology. 2017;**106**:35-47. DOI: 10.1016/j.enzmictec.2017.06.013

[19] Flavonoids [Internet]. Available from: http://lpi.oregonstate.edu/mic/dietary-factors/phytochemicals/flavonoids [Accessed: March 25, 2018]

[20] Tadeusz A. Alkaloids-Secrets of Life. Amsterdam: Elsevier; 2007