Agronomy Research **12**(3), 821–824, 2014

Comparative study on anti-oxidant activity of garlic grown in different regions

R. Vokk*, E. Tedersoo, T. Lõugas, K. Valgma and J. Rosend

Department of Food Processing, Tallinn University of Technology,
Ehitajate tee 5, Tallinn, EE19086, Estonia; *Correspondence: raivo.vokk@ttu.ee

Abstract. Currently reliance on natural products such as garlic and other vegetables is gaining popularity to combat various physiological threats including oxidative stress, cardiovascular complexities, cancer insurgence, and immune dysfunction. Garlic (*Allium sativum* L.) holds a unique position in history, belongs as a natural ingredient to different cuisines and was recognized for its therapeutic potential. Extensive research work has been carried out on the health promoting properties of garlic, often referred to its sulfur containing metabolites i.e. allicin and its derivatives. The aim of the present study was to compare garlic originated from different parts of the world (Chinese, Spanish, Lithuanian etc) on the basis of their anti-oxidant activity to evaluate their potential for different applications. As a result distinctive differences have been found in anti-oxidant activity of different garlic varieties. Garlic grown in Estonia possessed the highest antioxidant activity among the raw varieties. Black garlic has remarkable higher anti-oxidant content in comparison with other garlic samples.

Key words: anti-oxidant content, garlic, black garlic.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the bulbous rooty vegetables, which has been used for many centuries both as a flavouring agent and as a home remedy for the treatment of different health disorders. This vegetable is still mostly valued in different parts of the world due to its content of various flavouring components mostly presented by sulfur-containing chemical compounds. It has been shown that garlic aroma character is determined by the presence of di-2-propenyl disulfide (Gorinstein et al., 2005). Fortunately, garlic is also amongst a number of herbs having strong anti-microbial properties (Vokk, 1996). In recent decades application of garlic in phytotherapy has been widely investigated (Omar et al., 2007; Gorinstein et al., 2010).

It is well known that aging garlic at a constant temperature and humidity without adding any additives to a raw material, increases polyphenol compound presence. Thus, aged black garlic should exert stronger anti-oxidant effect compared to raw garlic, without decreasing the original effectiveness of the garlic. Gorinstein et al (2005) have shown that the bioactive compounds, electrophoretic patterns, and anti-oxidant potential of fresh Polish, Ukrainian and Israeli garlic samples are comparable but garlic samples subjected to heating at 100°C during 20 minutes preserve their bioactive compounds and anti-oxidant potential.

Even for the recommendations given by the physicians who wish to offer a patient herbal option for anti-microbial and/or anti-oxidative agents having several options to choose from.

MATERIALS AND METHODS

Physico-chemical and anti-oxidative measurements were performed to study garlic varieties grown in different climate conditions to compare their anti-oxidant activity.

The garlic samples were harvested in 2012–2013, the garlic bulbs were clean, white or greyish and well cured, the cloves were firm to the touch. The Estonian garlic was purchased from the producer Kadastiku in South Estonia. Other samples were purchased on the local market.

Black garlic (in the present work was used processed Spain garlic harvested in 2012) was also included into the study and the material was produced in 2013 by FS Baltic. Black garlic was produced by method of aging garlic, which in an embodiment involved the following procedures: classifying the garlic according to its condition and pre-treating it to achieve clean appearance; sealing the garlic in a vinyl pack by 10 kg and storing it in a tray; putting said tray in an aging device for a black garlic, applying steam and heat for 1–3 h while maintaining a temperature of 80–100°C inside the aging device, and treating by steam under a high temperature and high humidity condition; main aging by applying steam and heat to the treated garlic for 198 h while maintaining a temperature of 72–78°C inside the aging device; after-aging by applying steam and heat to the garlic, which had undergone main aging process, for 35 h while maintaining 60–69°C temperature inside the aging device; drying the after-aged garlic for 51 h while maintaining a temperature of 50–58°C inside the aging device; and low temperature after-aging by cooling obtained dried garlic at low temperature for 168 h while maintaining 0–5°C temperature inside the aging device. Provided here the method of aging black garlic characterized by drawing optimum time and condition without taking the storage condition, size, etc of the garlic (US Patent No US20110129580).

Sample preparation was performed as follows: 20 g of garlic was pounded with a pestle in a mortar until no garlic structure was recognizable any more (during a minute). To 0.5 g of disrupted material 20 ml of water (for the water soluble anti-oxidant measurements or 20 ml of methanol for lipid soluble anti-oxidant measurements) was added, shaked vigorously on Fortex and centrifuged 2 minutes at 13,200 rpm. 1 ml of supernatant was taken from both samples to perform anti-oxidant measurements. All the measurements of anti-oxidant activities were perfomed with the aim on Photochem, Analytik Jena. Preparation of the calibration curve was performed as described in the standard kit protocol ACL and ACW using volumes as displayed in the schemes in Manual (Photochem, Manual).

According to the principle of the ACW and ACL measurement method the free radicals were produced by optical excitation of a photosensitizer substance. Those radicals were partially eliminated from the sample by reaction with the anti-oxidants presented in the sample. In the measuring cell the remaining radicals caused the detector substance to luminescence and thereby the anti-oxidant capacity of the sample is determined. The anti-oxidative capacity of the sample was quantified by comparison with the standard (constructed calibration curve with ascorbic acid or Trolox).

At least four parallels were performed. All samples needed dilution and the dilution rate was taken into account for final calculations. The results were given as ascorbic acid equivalent for water soluble anti-oxidants and Trolox equivalent for lipid soluble anti-oxidants in all investigated samples.

RESULTS AND DISCUSSION

In all garlic samples the moisture content has been determined by Halogen Moisture Analyzer and the results are given in Tabel 1.

Tabel 1. Moisture content of different garlic varieteis

Origin and year of harvesting	Moisture content, %
Estonian 2012	57.8
Chinese 2012	67.61
Spanish2012	37.66
Lithuanian 2013	63.17
Polish 2013	59.48
Chinese 2012 in a set	54.35
Black garlic 2013	45.37

Moisture content of different garlic samples varies significantly in the range from 37.66 to 67.61%. Moisture content was taken into account for further calculations of anti-oxidant acitivity.

In Tabel 2 all the calculations concerning the water soluble anti-oxidants and lipid soluble anti-oxidants are given per 1 g of dry weight of the product and also per 1 g of the product itself.

Tabel 2. Anti-oxidant activity of garlic samples (ACW – water soluble anti-oxidants and ACL – lipid soluble anti-oxidants)

Sample origin	ACW expressed as ascorbic acid		ACL expressed as Trolox equivalent	
	μmol $1g^{-1}$ dry weight	μmol $1g^{-1}$ product	μmol $1g^{-1}$ dry weight	μmol $1g^{-1}$ product
Estonian 2012	524.07	221.16	3.35	1.41
Chinese 2012	85.02	27.54	4.32	1.40
Spanish2012	14.05	8.76	2.40	1.50
Lithuanian2013	30.46	11.22	8.34	3.07
Polish 2013	16.94	6.86	11.32	4.59
Chinese 2012, in a set	84.25	38.46	6.51	2.97
Black garlic 2013	1,082.92	591.60	7.96	4.35

As a result distinctive differences have been found in anti-oxidant activity of different garlic varieties. Over 90 times higher anti-oxidant content in Spain garlic has been observed after aging process. Lipid soluble anti-oxidant content had less remarkable differences. Would be interesting to produce black garlic from Estonian garlic expressing very high anti-oxidant content in a raw material. Over the past decades the application of herbs and other natural products has gained popularity, mint, garlic, pumpkin and beetroot amongst them. Garlic is known as a potent cardiovascular agent (Capasso, 2013). Therefore, garlic is a proper supplement in anti-atherosclerotic diets (Gorinstein et al., 2005). Latest investigations have given information about a possible role of black garlic in treatment of type 2 diabetes mellitus (Lee, 2009).

CONCLUSIONS

Garlic has been studied as one of the vegetables possessing comparatively high anti-oxidative activity. However the garlic bioactive value differs depending on the region, as it has been shown in the present investigation. It should be interesting to estimate different cultivars grown in the same region under the similar climatic conditions. Black garlic has very high potential as the source of anti-oxidants and it could be explained by changes in the chemical composition during the aging process.

REFERENCES

Capasso, A. 2013. Anti-oxidant action and therapeutic efficacy of *Allium sativum* L. *Molecules,* **18**(1), 690–700.

Gorinstein, S., Drziewiecki, J., Leontowicz, H., Leontowitcz, M., Naiman, K., Jastrzebski, Z., Zachwieja, Z., Barton, H., Shtabsky, B., Katrich, E. & Trakhtenberg, S. 2005. Comparison of the bioactive compounds and anti-oxidants potentials of fresh and cooked Polish, Ukrainian, and Israeli garlic. *J. Agric. Food. Chem.,* **53**, 2726–2732.

Gorinstein, S., Leontowicz, H., Leontowicz, M., Jastrzebski, Z., Najman, K., Tashma, Z., Katrich, E., Heo, B., Cho, J., Park, Y. & Trakhtenberg, S. 2010. The influence of raw and processed garlic and onions on plasma classical and non-classical atherosclerosis indices: investigations *in vitro* and *in vivo*. *Phytother Res*, **24**, 706–714.

Lee, Y., Gweon, O., Seo, Y., Im, J., Kang, M., Kim, M. & Kim, J. 2009. Anti-oxidant effect of garlic and aged black garlic in animal model of type 2 diabetes mellitus. *Nutr. Res. Pract.,* **3**(2), 156–161.

Omar, S.H., Abshar, U.H. & Nehal, M. 2007. Anti-carcinogenic and anti-tumorigenic effect of garlic and factors affecting its activity: a review. *Pharmacogn Rev.,***1**, 215–221.

Photochem. Manual. Analytik Jena AG, 2003,2, 79

Vokk, R. & Loomägi, T. 1996. Anti-microbial properties of onion and garlic preparations. *Proc. Estonian Acad. Sci. Biol.,* **45**, ½: 68–72.

US Patent US201110129, 2009, published in 2011.