Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 2706-2709
Received: 07-07-2017
Accepted: 08-08-2017

K Shunmugapriya
M.Sc (Food Science and Nutrition), Home Science College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

A Kalaiselvan
Assistant professor (Food Science and Nutrition) - Krishi Vigyan Kendra, Agricultural College and Research Institute, Tamil Nadu Agricultural University Madurai, Tamil Nadu, India

Correspondence
K Shunmugapriya
M.Sc (Food Science and Nutrition), Home Science College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

Influence of domestic cooking methods on proximate and phytochemical composition of garlic

K Shunmugapriya and A Kalaiselvan

Abstract
Nutrient content of garlic changed by different ways of cooking such as boiling, steaming and frying. This study is conducted to determine the proximate composition and phytochemical content of two varieties of garlic after cooking procedures and finding out the best way of cooking. Two different varieties (Big and Small clove) of garlic were purchased from local market of Madurai, Tamil Nadu. One portion was kept as raw as control and others were subjected to three different cooking methods. Nutrient such as moisture, starch, protein, fat, fibre, total polyphenols and total flavanoids were analyzed in cooked (steamed, boiled, fried) garlic by adopting standardized procedures to find out the best method of cooking. Fresh garlic contained 65.23±0.15 to 67.23±0.49% of moisture, 106.55±0.36 to 142.63±0.59g of starch, 7.14±0.06 to 7.30±0.45 % of protein, 0.15±0.06 to 0.30±0.02 % of fat, 0.82±0.02 to 1.46±0.35 % of fibre, 45.55±0.21to 49.59±0.39mg of total polyphenols and 3.51±0.02 to 4.27±0.02mg of total flavonoids. After cooking, with respect to moisture and polyphenols, nutrients were significantly reduced in all the treatments and other nutrients were nonsignificantly reduced in steaming method and significantly reduced in boiling and frying method. Studies shown that, steaming is the best method of cooking for nutrient retention when compared to other two methods.

Keywords: Garlic, Proximate compositions, Phytochemical compounds, Cooking methods.

1. Introduction
Garlic (*Allium sativum*) belongs to the family Alliaceae is one of the 600 known species including onion, shallots and leek [1]. It is broadly classified into two varieties hard neck (*ophioscordon*) and soft neck (*sativum*) [2] Garlic has been used as spice and food ingredient in cooking all over the world because it combines well with enormous range of foods, adding its own aroma and flavor as well as enhancing the flavor of the foods with which it is mixes [3].
Garlic has a prominent role in consumption due to the presence of many nutrients like carbohydrates proteins, phosphorous, potassium, calcium, and magnesium. Fresh raw garlic contains 64.38±0.56g of moisture, 6.92±0.20 g of protein, 1.40±0.11 g of ash, 0.16±0.02 g of fat, 5.22±0.41 g of total dietary fibre, 21.93±0.82 g of carbohydrate, 14.84±0.97g of total starch, 12.62±1.15mg of ascorbic acid, 33.91±6.10µg of total carotenoids, 1.05±0.15mg of iron and 119±10.9mg of phosphorus [4].
It has a higher concentration of sulphur compounds than any other Allium speices which are responsible for garlic's pungent odor and many of the medicinal effects. One of the most biologically active compound in garlic is allicin which give off garlic's characteristics aroma [5].
Garlic contains 33 sulphur compounds, Several enzymes, minerals like germanium, calcium, copper, iron, potassium, magnesium, selenium and zinc, vitamin A. vitamin B1, and vitamin C. Garlic is also found to contains 17 amino acids such as lysine histidine, arginine, aspartic acid, threonine, serine, glutamine, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tryptophan and phenylalanine [6].
Cooking method affects the nutrient content of garlic in positive and negative ways. Generally moist heat and dry heat methods are adopted for any cuisine preparation. Cooking methods have direct influence on the nutritional content of garlic. Most of the water soluble nutrients will leach out while using water as medium. Likewise fat content will increase in food while using fat as cooking medium. In this study, an attempt was made to find out the best method of cooking of garlic by comparing the nutrient retention of cooked garlic with raw garlic.

Material and Methods
Materials
Two different varieties of garlic (garlic with big clove and small clove) were purchased from local market of Madurai, Tamil Nadu. One portion was kept as raw as control and others were subjected to three different cooking method. The following standardized procedures were used

to determine the nutrient content of both cooked and raw garlic. The raw sample is named as V_1T_0 and V_2T_0 for variety 1 and 2 respectively.

Sample preparation
The vegetables were cooked in our laboratory, after cleaning and washing with water (in consumer conditions) and after separating the non-edible portion and cutting into small pieces.

Steaming
Steaming is done in special equipment called like idli cooker. In which steam is generated from boiling water or liquid in the pan so that garlic is completely surrounded by steam and not in contact with water. In this way, garlic is cooked for 10 min at 100 ºC. The sample prepared by using this method is named as V_1T_1 and V_2T_1 for variety 1 and 2 respectively.

Boiling
Portable water was taken as a medium of cooking in this method. The water was allowed to boil and the cleaned and chopped garlic was cooked in boiling condition until it is well cooked (10 min) and then it was allowed to cool to room temperature. The sample prepared by using this method is named as V_1T_2 and V_2T_2 for variety 1 and 2 respectively.

Frying
The garlic samples were placed in a frying pan with hot refined sun flower oil
(169 ^{0}C), and stirred until the sample become crisp and tender. The sample prepared by using this method is named as V_1T_3 and V_2T_3 for variety 1 and 2 respectively.

Methods
Estimation of Moisture
The moisture content of the sample was estimated by the hot air oven method [7]. The sample was dried at 110°C. The drying was continued till a concordant reading was obtained. The moisture content was expressed in percentage.

Estimation of starch
The starch content was analyzed by a method described by Sadasivam and Manickam method [8]. The absorbance were read at the intensity of green to dark green colour at 630 nm. The amount of starch present in the sample tube was calculated from the graph.

Estimation of Protein
Protein was analyzed by the amount of nitrogen available in the sample by micro kjeldhal method [9]. The nitrogen value multiplied by factor 6.25 gives the crude protein content of the sample in per cent

Estimation of Fat
The fat content of the sample was estimated by the method described by Cohen [10]. The lipid in the sample was extracted with petroleum ether (60-80 ºC) in soxplus apparatus for two hours. The fat content was expressed as percentage.

Estimation of Crude fibre
The crude fibre content was determined by acid and subsequent alkali hydrolysis method. [11]. The results were expressed as percentage.

Total phenolic contents
Total phenolic content were determined using Folin-Ciocalteu method with slight modification [8]. The concentration of total phenols in methanolic extracts of each sample was calculated by using the standard graph. The total phenolic contents were expressed in mg Gallic acid equivalent 100g-1 of sample in dry weight basis

Total Flavonoids
Total flavonoids content present in the selected garlic were estimated by the aluminum chloride colorimetric assay [12]. The concentration of total flavonoids in methanolic extracts of each sample was calculated by using the standard graph. The total flavonoids contents were expressed in mg Quercetin equivalent 100g-1 of sample in fresh and dry weight basis.

Statistical analysis
To verify the statistical significance of the studied parameters means (M) of three time analyzed samples ± standard deviation (SD) were defined. When appropriate, differences between groups were tested by paired t test by using SPSS software. The P values of <0.05 were considered to be significant.

Results and discussion
From the present experiment, it was perceived that moisture content of raw garlic is 65.23±0.15% and 67.23±0.49% in variety 1 and 2 respectively and this values were increased to 67.66±0.49 to 65.53±0.50 and 67.73±0.40 to 67.5±1.57 in variety 1 and 2 for steamed and boiled garlic respectively, Simultaneously, decreasing trend were observed in moisture content of fried garlic. The statistical analysis showed that a significant difference were found among the cooking methods Moisture of garlic cooked by various cooking method were ranged between 38.94 and 70.75g/100g [13]. These results were similar to the present investigation.
Starch content of steamed garlic is non-significantly decreased from raw garlic in both the variety from 142.63±0.59 to 117.36±0.56 in variety 1 and from 106.55±0.36 to 101.84±0.56 in variety 2. In case of boiled and fried garlic, starch content was significantly reduced from raw garlic for both the varieties at $p< 0.05$ level.

Table 1: Proximate composition of raw and cooked garlic - Big clove

Treatments	Moisture (%)	Starch (g/100g)	Protein (%)	Fat (%)	Fibre (%)
V_1 T_0	65.23±0.15	142.63±0.59	7.14±0.06	0.15±0.06	0.82±0.02
V_1 T_1	67.66±0.49	123.43±0.96	6.68±0.07	0.15±0.07	0.79±0.06
V_1 T_2	65.53±0.50	121.16±0.47	6.50±0.03	0.14±0.05	0.78±0.03
V_1 T_3	65.46±0.37	117.36±0.56	6.21±0.23	0.23±0.03	0.78±0.06

Table 2: Proximate composition of raw and cooked garlic - Small clove

Treatments	Moisture (%)	Starch (g/100g)	Protein (%)	Fat (%)	Fibre (%)
V_2 T_0	67.23±0.49	106.55±0.36	7.30±0.45	0.30±0.02	1.46±0.35
V_2 T_1	67.73±0.40	105.73±0.30	7.27±0.26	0.30±0.04	1.45±0.47
V_2 T_2	67.50±1.57	103.30±0.65	6.25±0.33	0.28±0.04	1.43±0.25
V_2 T_3	66.63±0.58	101.84±0.65	6.93±0.24	0.32±0.04	0.44±0.03

The fresh garlic contained 7.14±0.06 and 7.30±0.45 per cent of protein in variety 1 and 2 respectively whereas cooked garlic had protein content in the range of 6.21±0.23 to 7.27±0.26 for both the variety. These results are in accord with previous study [14]. Drastic changes were not observed after cooking in the level of protein content. Statistical analysis revealed that protein content was insignificantly differed among the treatments. These decreases may be caused by diffusion of the contents into cooking water [15].

With respect to fat content, levels in cooked garlic were similar to those of raw ones, excepting some significant increases for frying ($p< 0.05$). Fat contents of fried garlic ranged between 0.23±0.03 and 0.32±0.04 per cent for variety 1 and 2 respectively. While those of non-fried products (boiling and steaming) was shown as 0.15±0.06 to 0.14±0.05 and 0.30±0.04 to 0.28±0.04. These results are in accord with those of previous studies [13].

Fibre content of fresh garlic is varied between 0.82±0.02 and 1.46±0.35 per cent. The highest contents of total fibre in garlic were obtained after steaming (0.79±0.06 and 1.45±0.47). The lowest retention of total fibre was observed in garlic after boiling and frying.

Table 3: Phytochemical composition of raw and cooked garlic - Big clove

Treatments	Total polyphenol (mg/100g)	Total flavonoids (mg/100g)
V_1 T_0	45.55±0.21	3.51±0.02
V_1 T_1	42.29±0.38	3.31±0.07
V_1 T_2	41.62±0.63	3.26±0.03
V_1 T_3	41.42±0.500	3.33±0.02

Table 4: Phytochemical composition of raw and cooked garlic - Small clove

Treatments	Total polyphenol (mg/100g)	Total flavonoids (mg/100g)
V_2 T_0	49.59±0.39	4.27±0.02
V_2 T_1	47.61±0.10	4.21±0.02
V_2 T_2	46.22±0.72	4.15±0.04
V_2 T_3	46.11±0.21	4.15±0.01

The total polyphenol content in raw and cooked garlics, expressed as milligrams of gallic acid equivalent per 100 g of fresh weight. Total polyphenol content of raw, boiled, steamed and fried garlic content is varied between 41.62±0.63 and 45.55±0.21 in variety 1 and for variety 2, the values ranged from 49.59±0.39 to 45.22±0.72. Polyphenol losses could also be due to the covalent binding between oxidized phenols and proteins or amino acids as well as the polymerization of oxidized phenols. Statistical results showed that the all the treatments were significantly differed from raw garlic contents [16].

Among the three treatment, the maximum retention of flavanoid was found in steamed garlic. The values are 3.33±0.07 in variety 1 and 4.21±0.02 in variety 2 whereas the raw garlic flavanoid content is 3.51±0.02 in variety 1 and 4.27±0.02 in variety 2. Using steaming as pretreatment for microwave drying process, flavonoid content in some vegetable samples increases by 0.70 to 3.70 times when compared to other methods which does not involve pretreatment. During the processing, heat results the hydrolysis of glycosides and releases flavonoid monomers. Heat increases chemical extraction in samples and may be induced by the steaming [17].

Conclusion

The present study indicates that, steaming had minimal effects on proximate as well as phytochemical composition. On the other hand, frying and boiling were two popular domestic cooking methods, caused great losses of these compounds. To best retain nutritional values at maximum level, consumers may process the garlic by steam cooking, a 'friendly' and 'better' process, in-stead of domestic boiling and frying methods. Moreover, these results suggest further studies are needed to identify a preferential cooking method for each vegetable to improve the nutritional quality and their reliability.

References

1. Rehman K. Garlic and aging: new insight into an old remedy. Age. Res. Rev. 2003; 2:39-56.
2. Borek C. Antioxidant health effects of aged garlic extract. J. Nutr. 2001; 131(3):1010-1015.
3. Woodward P. Garlic and friends: the history, growth and use of edible Alliums. Hyland House, South Melbourne, Australia, 1996.
4. Longvah T, Ananthan R, Bhaskarachary K, Venkaiah K. Indian Food Composition Tables. National Institute of Nutrition, Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India, India. 2017; 44, 107,137:163.
5. Pedrazza-Chaverri J, Tapia E, Medina-Campos ON, de los Angeles Granados M, Franco M. Garlic prevents hypertension induced by chronic inhibition of nitric oxide synthesis. Life Sci. 2006; 62:71-77.
6. Josling PA. The heart of garlic Nature's aid to healing the human body, HEC Publishing, Chicago Illinois, 2005, 20.
7. Ranganna S. Manual of analysis of fruits and vegetables products, Tata McGraw Hill publishing Co., Ltd., New Delhi. 1995; 1-2(7-11):13.
8. Sadasivam S, Manickam A. Biochemical Methods. Third Edition, New Age International Publishers, New Delhi, India. 2008, 203-204
9. Ma T, Zuazaga G. Estimation of protein. Ind. Eng. Chem., Anal. Edn. 1942; 14(280):1-2, 7-11, 13.
10. Cohen EH. Journal of Association of Analytical Chemistry. 1917; 54:212.
11. Maynard AJ. Methods in Food Analysis. Academic press, New York. 1976, 176.
12. Marinova D, Ribarova F, Atanasova M. Total phenolics and flavonoids in Bulgarian fruits and vegetables. Journal of the University of Chemical Technology and Metallurgy. 2005; 40(3):255-260.
13. Cai Jia-H, Shin J-A, Kim Y-M, Lee K-T. Effect of processing on composition changes of

selected spices. PLoSONE 2017; 12(5):e0176037. https://doi.org/10.1371/journal.pone.0176037
14. Marina Sajid, Masood Sadiq Butt, Aamir Shehzad, Saira Tanweer. Chemical and mineral analysis of garlic: a golden herb Pak. J Food Sci., 2014; 24(2):108-110
15. Alajaji SA, El-Adawy TA. Nutritional composition of chickpea (*Cicer arietinum* L.) as affected by microwave cooking and other traditional cooking methods**.** J Food Compos Anal 2006; 19:806-812.
16. Friedman M. Food browning and its prevention: An overview. J. Agric. Food Chem. 1996; 44:631-653.
17. Liga Priecina, Daina Karlina. Total Polyphenol, Flavonoid Content and Antiradical Activity of Celery, Dill, Parsley, Onion and Garlic Dried in Conventive and Microwave-Vacuum Dryers. International Conference on Nutrition and Food Sciences. 2013, 53.