

The Effect of Microwave Cooking on Nutrient Value of Fresh Vegetables

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Abstract: Microwave cooking has gained considerable importance as an energy-saving, convenient and time-saving cooking method. This study was performed to compare the effects of microwave cooking and conventional cooking method on proximate nutrient and health promoting contents of fresh Cowpea (*Vigna unguiculata*) and Zhinggye (*Luffa acutangula*) grown in Bangladesh. The moisture and ash content in raw Cowpea were 92.19% and 0.48%, respectively, for Zhinggye they were 95.87% and 0.25%, respectively. After conventional cooking moisture and ash content were 93.37% and 0.33%, respectively, for Cowpea whereas 95.75% and 0.23%, respectively, for Zhinggye. On the other hand, after microwave cooking these values were 92.32% and 0.48%, respectively, for Cowpea and 95.53% and 0.25%, respectively, for Zhinggye. Total crude protein, fat and carbohydrate were significantly modified by both cooking methods. In both cases, microwave cooking decreased the vitamin-C content to some extent but the conventional cooking completely destroyed the vitamin-C contents.

Keywords: Microwave Cooking, Nutritional Value, Fresh Vegetables, *Vigna Unguiculata*, *Luffa Acutangula*

1. Introduction

Cooking as a domestic processing method has a great impact on food nutrients. In general, vegetables are prepared at home on the basis of convenience and taste preference rather than retention of nutrient and health-promoting compounds [1]. It is known that cooking induces significant changes in chemical composition, affecting the bioavailability and content of chemopreventive compounds in vegetables. Cooking methods were shown to affect the contents of nutrient and health-promoting compounds such as vitamin C, carotenoids, polyphenols, and glucosinolates [2-5]. The cooking procedures such as boiling and microwaving used in these studies were based on the dietary habit in Bangladesh. The microwave cooking process presents controversial results in the literature due to the different conditions that are employed (time, power, and added water).

Cowpeas (*Vigna unguiculata* L.) are one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, Southern Europe and Central and

South America. A drought-tolerant and warm-weather crop, cowpeas are well-adapted to the drier regions of the tropics, where other food legumes do not perform well. It also has the useful ability to fix atmospheric nitrogen through its root nodules, and it grows well in poor soils with more than 85% sand and with less than 0.2% organic matter and low levels of phosphorus [6]. Cowpea seed and its protein isolate are useful for remedying diet-induced hypercholesterolemia and steatosis, even in diets containing high levels of saturated fatty acids and cholesterol. The effectiveness of the isolate is lower than that of the whole seed, probably because several components, such as plant sterols, saponins, resistant starches, and soluble fiber present in the intact seed can act synergistically [7].

Zhinggye (*Luffa acutangula* L.) is an important warm season cucurbitaceous vegetable crop grown in different parts of Bangladesh, India and in the tropical countries of Asia and Africa. Its immature fruits are cooked as vegetable and also used in the preparation of chutneys and curries. Being a warm season crop, it has the ability to tolerate hotter conditions, which makes it suitable for widespread

cultivation throughout the tropics [8]. A natural jaundice remedy, the fruits of *Luffa acutangula* are grown, harvested before maturity and is very popular in Asia. Ridge gourd as whole, seeds and dried crusts are all used for medicinal purposes [9].

This study tried to reveal a suitable cooking method which will help to provide us more nutrient rich cooked food by comprising conventional cooking and microwave cooking method so that it is possible to overcome the nutrient lacking problems.

2. Materials and Methods

2.1. Preparation of Sample

Fresh vegetables Cowpea (*Vigna unguiculata* L.) and Zhingye (*Luffa acutangula* L.) were collected from local market (Sheikh Para, Kushtia, Bangladesh). Samples were washed properly and cut into small pieces from the edible part of the green vegetables.

2.2. Conventional Cooking

Among various methods of conventional cooking, boiling method was applied in the study for the cooking of the selected sample. In this case, the sample to be cooked was just immersed in water at 100°C and the water was maintained at that temperature till the sample was tendered. In this cooking method, each sample was cooked for 10 minutes.

2.3. Microwave Cooking

A weighed, chopped sample was placed in a 250-ml beaker. The sample in the microwave oven was cooked until it is tender (about 45 s in a 700W oven). Remove the sample from the oven and the nutrition values were estimated.

2.4. Determination of Moisture Content

Moisture was determined by oven drying method. A clean crucible was dried to a constant weight in air oven at 110°C, cooled in a desiccator and weighed (W1). Two grams of finely ground sample was accurately weighed into the previously labeled crucible and reweighed (W2). The crucible containing the sample was dried in an oven to constant weight (W3). The percentage moisture content was

$$\% \text{ Moisture content} = \frac{(W2 - W3) \times 100}{W2 - W1}$$

2.5. Determination of Ash Content

calculated as follows:

$$\% \text{ Ash content} = \frac{(W3 - W1) \times 100}{W2 - W1}$$

2.6. Determination of Protein Content

Protein in the sample was determined by Kjeldahl method [10]. 2 g of dried samples was taken in digestion flask. Add 10-15 ml of concentrated H₂SO₄ and 8 g of digestion mixture i.e. K₂SO₄:CuSO₄ (8:1). The flask was swirled in order to mix the contents thoroughly then placed on heater to start digestion till the mixture become clear (blue green in color). It needs 2 hrs to complete. The digest was cooled and transferred to 100 ml volumetric flask and volume was made up to mark by the addition of distilled water. Distillation of the digest was performed in Markam Still Distillation Apparatus [11]. Ten milliliters of digest was introduced in the distillation tube then 10 ml of 0.5 N NaOH was gradually added through the same way. Distillation was continued for at least 10 min and NH₃ produced was collected as NH₄OH in a conical flask containing 20 ml of 4% boric acid solution with few drops of modified methyl red indicator. During distillation yellowish color appears due to NH₄OH. The distillate was then titrated against standard 0.1 N HCl solution till the appearance of pink color. A blank was also run through all steps as above. Percent crude protein content of the sample was calculated by using the following formula:

2.7. Determination of Fat Content

Protein in the sample was determined by Kjeldahl method [10]. 2 g of dried samples was taken in digestion flask. Add 10-15 ml of concentrated H₂SO₄ and 8 g of digestion mixture i.e. K₂SO₄:CuSO₄ (8:1). The flask was swirled in order to mix the contents thoroughly then placed on heater to start digestion till the mixture become clear (blue green in color). It needs 2 hrs to complete. The digest was cooled and transferred to 100 ml volumetric flask and volume was made up to mark by the addition of distilled water. Distillation of the digest was performed in Markam Still Distillation Apparatus [11]. Ten milliliters of digest was introduced in the distillation tube then 10 ml of 0.5 N NaOH was gradually added through the same way. Distillation was continued for at least 10 min and NH₃ produced was collected as NH₄OH in a conical flask containing 20 ml of 4% boric acid solution with few drops of modified methyl red indicator. During distillation yellowish color appears due to NH₄OH. The distillate was then titrated against standard 0.1 N HCl solution till the appearance of pink color. A blank was also run through all steps as above. Percent crude protein content of the sample was calculated by using the following formula:

the extraction tube. Weighed, cleaned and dried the receiving beaker was filled with petroleum ether and fitted into the apparatus. Turned on water and heater to start extraction. After 4-6 siphoning allow ether to evaporate and disconnect beaker before last siphoning. Transferred extract into clean glass dish with ether washing and evaporated ether on water bath. Then placed the dish in an oven at 105°C for 2 hrs and cooled it in a desiccator. The percent crude fat was determined by using the following formula:

$$\% \text{ Protein} = 6.25X = \frac{(\text{Sample Titration} - \text{Blank Titration}) \times \text{Strength of HCl} \times 0.014 \times \text{Volume of digest Sample} \times 100}{\text{Wt. of the sample} \times \text{Volume taken for Distillation}}$$

$$\% \text{ Fat content} = \frac{\text{Wt. of Ether Extract} \times 100}{\text{Wt. of Sample}}$$

2.8. Determination of Carbohydrate Content

The total carbohydrate was determined by difference. The sum of the percentage moisture, ash, crude protein and crude fat was subtracted from 100 [13].

% Carbohydrate = 100 - (moisture content + ash content + protein content + fat content)%

2.9. Determination of Vitamin C Content

Vitamin C content was determined according to the Association of Official Analytical Chemists (AOAC) Official Method 985.33 (2, 6-dichloroindophenol titrimetric method) [14]. Vitamin C content is expressed as mg/100 g fresh weight.

2.10. Statistical Analysis

The nutrient contents from these samples were estimated in triplicate, and mean values were calculated. A Student's t-test was computed for the statistical significance of the results.

3. Result and Discussion

Food preparation is an important step in meeting the nutritional needs of the family. Food has to be pleasing in appearance and taste in order to be consumed. Cooking as a conventional processing method has a great impact on food nutrients. Most foods are mainly consumed after being cooked and cooking considerably affects their health-promoting compounds, minerals and vitamins. In this study tried to picture the changes brought by cooking (microwave and conventional method) in the nutrient content of two fresh vegetables collected from local market named as Cowpea and Zhinggye.

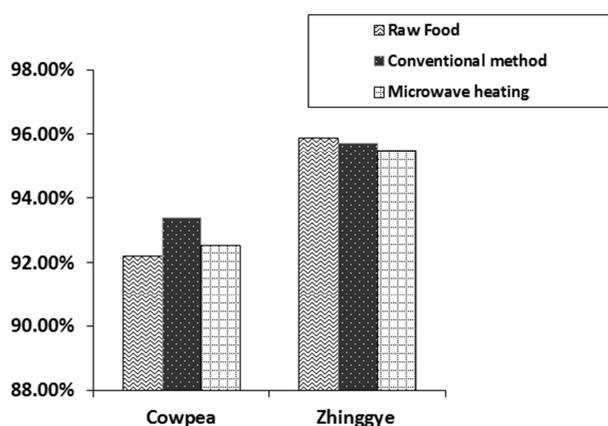


Figure 1. The moisture content in Cowpea and Zhinggye cooked by different methods.

Previous studied showed that raw samples of Cowpea contained 87% moisture, 0.2% fat, 3% protein, 9%

carbohydrate and Zhinggye contained 93% moisture, 0.6% fat, 1.8% protein, 4.3% carbohydrate. [15] In this study, the moisture content in raw Cowpea and Zhinggye were 92.19% and 95.87%, respectively. After conventional cooking moisture content in Cowpea and Zhinggye were 93.37% and 95.75%, respectively, whereas after microwaving, 92.32% and 95.53%, respectively, were found for Cowpea and Zhinggye (Figure 1). Ash content in raw Cowpea was 0.48%, but after conventional and microwave cooking it was found 0.33% and 0.48%, respectively. On the other hand, ash content in raw Zhinggye was 0.25%, but after conventional and microwave cooking it was found 0.23% and 0.25%, respectively (Figure 2).

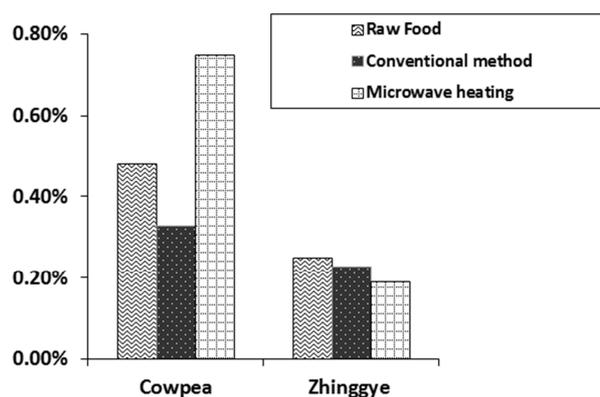


Figure 2. The ash content in Cowpea and Zhinggye cooked by different methods.

Total crude protein of raw Cowpea was 2.50%. After conventional and microwave cooking it was found 2.00% and 2.50%, respectively. On the other hand, crude protein content in raw Zhinggye was 0.94%, but after conventional and microwave cooking it was found 0.88% and 0.94%, respectively (Figure 3). As showed in Figure 4, crude fat in raw Cowpea was 0.048%. After conventional and microwave cooking it was found 0.027% and 0.019%, respectively. On the other hand, crude fat content in raw Zhinggye was 0.52%, but after conventional and microwave cooking it was found 0.44% and 0.28%, respectively.

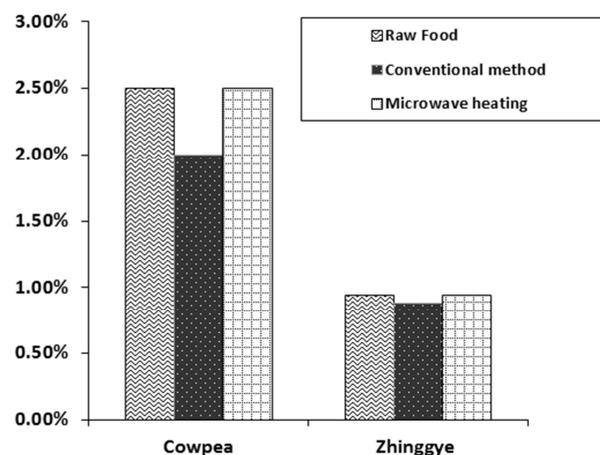


Figure 3. The protein content in Cowpea and Zhinggye cooked by different methods.

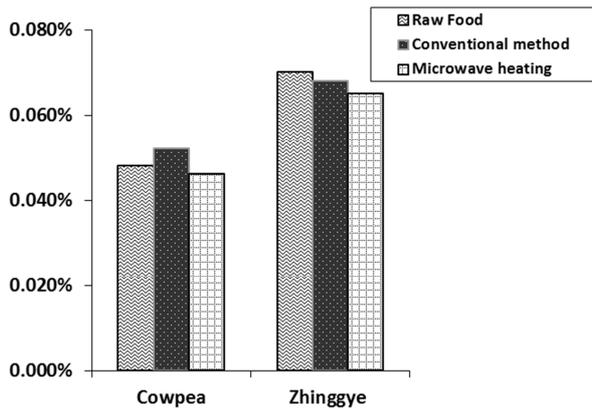


Figure 4. The fat content in Cowpea and Zhinggye cooked by different methods.

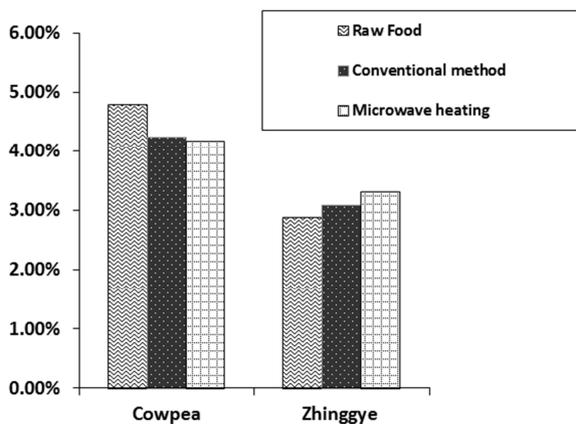


Figure 5. The carbohydrate content in Cowpea and Zhinggye cooked by different methods.

The carbohydrate content in raw Cowpea and Zhinggye was 4.78% and 2.42%, respectively. 4.27% carbohydrate was found in Cowpea after conventional cooking while 4.68% carbohydrate was found after microwave cooking. On the other hand, 2.7% carbohydrate was found in Zhinggye after conventional cooking while 3% carbohydrate was found after microwave cooking (Figure 5).

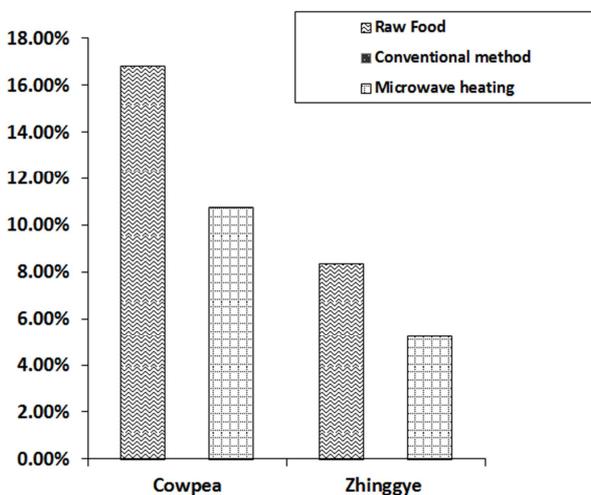


Figure 6. The Vitamin-C content in Cowpea and Zhinggye cooked by different methods.

Vitamin C is one of the most important nutrients in many other horticultural crops and has many biological functions in the human body [16]. The concentration of ascorbic acid (the predominant form of vitamin C) in fresh vegetables generally decreased after cooking [17]. Both cooking treatments caused a dramatic loss of vitamin C. 16.82% and 8.35% of vitamin C was observed in raw Cowpea and Zhinggye, respectively. After microwaving 10.78% and 5.24% of vitamin C was observed in Cowpea and Zhinggye, respectively, while conventional cooking completely destroyed the vitamin-C in both vegetables (Figure 6).

4. Conclusion

Cowpea (*Vigna unguiculata*) and Zhinggye (*Luffa acutangula*) have been cooked by microwave and conventional methods and compared these methods for protein, fat, carbohydrate, moisture, ash and vitamin C contents. Microwave heating has a number of quantitative and qualitative advantages over conventional heating techniques that make its adoption a serious proposition. One main advantage is the place where the heat is generated, namely the product itself. Because of this, the effect of small heat conductivities or heat transfer coefficients does not play such an important role. Therefore, larger pieces can be heated in a shorter time and with a more even temperature distribution. These advantages often yield an increased production. Bangladesh is an under developing country and many people of this country are suffering from nutritional problem. For this reason people should choose the best method of cooking by which nutrient content are present in high amount. Results of this study suggested that microwave cooking method is better than other methods because microwave cooked food contains high amount of nutrients.

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