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Mob: +92 300 3008585, Fax: +92 41 8815544

E-mail: editorpjn@gmail.com

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Antinutrient Factors of Vegetable Cowpea (*Sesquipedalis*) Seeds During Thermal Processing

E.A. Udensi[1], F.C. Ekwu[2] and J.N. Isinguzo[1]
[1]Department of Food Science and Technology, Abia State University, Uturu, Abia State, Nigeria
[2]Department of Food Science and Technology, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria

Abstract: The effect of boiling, roasting and autoclaving on the levels of some antinutrient factors present in the seeds of vegetable cowpea (sesquipedalis) were studied. The reduction of trypsin inhibitor was found to be highest (100%) with autoclaving at 60 min. Boiling was more effective in reducing phytic acid (68.34%) and haemagglutinin (75.98%) respectively at 60 min than the other processing treatments at the same time. The hydrogen cyanide was markedly reduced up to 81.25% at 15 min by autoclaving method while boiling at 60min resulted in (81.25%) reduction. Tannin content was reduced by boiling and roasting up to 75.00% at 60 min and 75.00% at 120 min respectively. Boiling and autoclaving at 60 min significantly reduced stachyose (60.52% - 84.21%) and raffinose (67.97 - 83.66%).

Key words: Autoclaving, boiling, roasting, anti nutritional factors, vegetable cowpea

Introduction

Vegetable cowpea (akidi) is botanically called *Vigna Unguiculata* sub-specie *sesquipedalis*. It is a vigorous climber reaching (2-4m) in height and twining anticlockwise, although prostrate forms exist. It belongs to the legume family leguminoseae and sub-family Papillinoadeae (Enwere, 1998). Food legumes particularly vegetable cowpea is one of the most important sources of protein, carbohydrate and Vitamins in the diet of many populations especially in developing countries (Philips and Mc Watters, 1991). However, the presence of the antinutritional factors commonly found in legumes is a major factor limiting the wider food use of such tropical plant (Liener, 1976). The presence of phytate in foods is known to lower the bioavailability of minerals (Davis and Nightingale, 1975, Eradman, 1979) and inhibits several proteolytic enzymes and amylases (Singh and Krikorian, 1982).

Tripsin inhibitor when ingested by man in large quantity disrupt the digestive process and may lead to undesirable physiological reactions (Booth *et al.*, 1960). The oligossaccharides (stachyose and raffinose) that are common in legumes seeds are thought to be the major producer of flatulence when legumes are consumed. It is therefore clearly desirable to decrease the oligossaccarides content of legumes and other antinutritional factors if they are to be most effectively exploited as inexpensive source of protein (Philip and Abbeyi, 1989). The use of some processing methods such as soaking, boiling and autoclaving are known to achieve reduction or elimination of the antinutritional factors (Udensi *et al.*, 2005, Khokhar and Chauhan, 1986), which affect the nutritional, and food quality of legumes.

The objective of this study is to investigate the effect of boiling, roasting and autoclaving time on the levels of some antinutritional factors in the vegetable cowpea seeds.

Materials and Methods

Vegetable cowpea (akidi) seeds were procured from Orie Ngodo Market at Isuochi, Umnneochi Local Govt. Area in Abia State, Nigeria. The seeds were thoroughly cleaned and sorted to remove extraneous matters. The processing methods employed were boiling, roasting and autoclaving.

Boiling: 500g portions each of the whole seeds were boiled in distilled water at the temperature of 100°C in the ratio of 1:10 w/v for 15,30,45 and 60 min; after which they were drained and oven dried at 60°C. The dried seeds were milled into flour using local attrition milling machine to obtain a particle size of 1mm mesh size.

Roasting: 500g portions each of the whole seeds were roasted separately using a hotbox oven at the temperature of 120°C for the time periods of 30,60,90 and 120 min. The seeds were removed from the oven, cooled and then milled into flour using the attrition milling machine to obtain the same particle size of 1mm mesh size.

Autoclaving: 500g portions each of the raw seeds were autoclaved at a pressure of 151b (120°C) for 15,30,45 and 60 min respectively. The autoclaved seeds were dehulled by hand rubbing, oven dried at 60°C to about 10% moisture content and milled into flour as described earlier.

Raw sample: The raw sample was processed into flour

Table 1: Effect of boiling, roasting and autoclaving on the levels of trypsin inhibitor, phytic acid and haemagglutinin in vegetable cowpea (*sesquipedalis*) seeds

Treatment	Trypsin inhibitor Tiu/g	Phytic acid mg/100g	Haemagglutinin Hu/g
Raw seeds	1113	4.25	11.20
Boiling in water			
15 min	752 (32.45)	2.85 (32.33)	6.93 (38.13)
30 min	583 (47.62)	2.30 (45.10)	6.14 (45.19)
45 min	559 (49.78)	1.75 (58.82)	4.53 (59.38)
60 min	535 (51.93)	1.35 (68.34)	2.69 (75.98)
Roasted			
30 min	865 (22.28)	2.05 (51.76)	6.92 (38.27)
60 min	853 (23.26)	1.90 (55.26)	4.66 (58.39)
90 min	435 (60.92)	1.80 (57.65)	3.64 (67.50)
120 min	304 (72.62)	1.60 (62.35)	3.64 (67.50)
Autoclaved			
15 min	29 (97.39)	3.95 (7.06)	6.46 (42.32)
30 min	22 (98.39)	3.85 (9.41)	6.16 (45.00)
45 min	0 (100.00)	3.65 (14.12)	4.23 (62.23)
60 min	0 (100.00)	3.45 (18.82)	4.46 (58.39)

by drying at 60°C to about 10% moisture content and milled to obtain the same particle size.

Analysis of antinutritional factors: Trypsin inhibitor and haemagglutinin activity were determined according to the methods described by Arntified *et al*. (1985). Phytic acid content was measured by the method of Davis and Reld (1979), while tannin was determined by the method of Folin-Dennis described by Pearson (1976). Hydrogen cyanide content was measured by the method described by Balagophalan *et al*. (1985). Stachylose and raffinose were determined by the Anthron method described by Ojiako and Akubugwo (1990).

Results and Discussion

Trypsin inhibitor activity: Effect of boiling, roasting and autoclaving on the trypsin inhibitor activity of raw *Vigna unguiculata* subspecie-*Sequipedalis* is presented in Table 1. It could be observed that the different processing methods employed brought about appreciable reduction in trypsin inhibitor activity (TIA). Increase in time of treatment generally increased the percentage reduction of trypsin inhibitor activity. Autoclaving at 45 min completely eliminated the TIA by 100%. The decrease in TIA with boiling, roasting and autoclaving may be due to the well established heat labile nature of trypsin inhibitor (Khokhar and Chauhan, 1986). Cooking and autoclaving have been reported to be effective in inactivating protease inhibitors in several food legumes (Liener, 1962 and Udensi *et al*., 2004).

Phytic acid: The effect of boiling, roasting and autoclaving on the level of phytic acid is also given in Table 1. The seeds of vegetable cowpea as observed in the table showed a loss of phytic acid (68.34%) at 60 min. boiling. Udensi *et al.,* (2005), has obtained similar result of loss of phytate (68.04%) in *Mucuna sloanie*. The observed decrease in phytic acid content of legume seeds during boiling may be partly due to the formation of insoluble complexes between phytate and other components.
Roasting reduced the phytate content by up to 62.35% following the same trend of reduction by boiling. The reduction in phytate by roasting may be due to the heat labile nature of phytic acid. Autoclaving (Table 1) has the lowest reduction effect. (18.82%) at 60 min. This same level of loss of phytic acid has been observed in *Mucuna sloanie* by Udensi *et al*. (2005).

Haemagglutinin: Effects of boiling, roasting and autoclaving on the Haemagglutinin content of vegetable cowpea are presented on Table 1. Boiling at 60min markedly reduced Haemagglutinin by 75.98% while autoclaving at 45min reduced haemagglutinin by 62.23%. Udensi *et al*. (2005) reported similar reduction of Haemagglutinin in *Mucuna sloanie*. Roasting was equally effective in reducing haemagglutinin content by 67.50% at 120 min.

Tannin: Table 2 summaries tannin value in raw and processed vegetable cowpea (akidi) beans. Boiling for 60 min in distilled water and autoclaving for 60 min resulted in 75% and 62.50% tannin reduction respectively. The reduction in tannin content during boiling and autoclaving is as a result of the fact that tannins are polyphenols and all polyphenolic compounds are water soluble in nature (Kumar *et al*., 1979). Therefore reduction in tannin content may be attributed to leaching out of phenols into the cooking medium under the influence of the concentration gradient (Vijayakumani *et al* .,1992)
Roasting for 120 min also decreased the tannin content up to 75%. Since tannins are mostly located at the seed coat (Singh, 1988), dehulling which took place after roasting must have contributed to the reduction of the level of tannin content in the vegetable cowpea.

Table 2: Effect of boiling, roasting and autoclaving on the levels of HCN, tannin and oligossaccharides in vegetable cowpea (*sesquipedalis*) seeds

Treatment	HCN Mg/kg	Tannin %	Raffinose g/100g	Stachyose g/100g
Raw seed	3.20	0.40	0.38	1.53 (21.57)
Boiling in water				
15 min	1.60 (50.08)	0.35 (12.50)	0.30 (21.05)	1.19 (22.22)
30 min	1.20 (62.50)	0.30 (25.00)	0.23 (39.47)	0.93 (39.22)
45 min	1.20 (62.50)	0.25 (37.00)	0.15 (60.52)	0.60 (60.78)
60 min	0.60 (81.25)	0.10 (75.00)	0.15 (60.52)	0.40 (67.97)
Roasted				
30 min	2.80 (12.50)	0.35 (12.50)	0.29 (23.68)	1.20 (21.57)
60 min	1.60 (50.00)	0.30 (25.00)	0.29 (23.68)	1.20 (21.57)
90 min	1.60 (50.00)	0.25 (37.00)	0.26 (31.21)	1.06 (30.72)
120 min	1.20 (62.50)	0.10 (75.00)	0.25 (34.21)	1.60 (34.64)
Autoclaved				
15 min	0.60 (81.25)	0.25 (37.00)	0.30 (21.05)	1.20 (21.57)
30 min	0.60 (81.25)	0.25 (37.00)	0.22 (42.11)	0.88 (42.48)
45 min	0.40 (87.50)	0.15 (62.50)	0.14 (63.16)	0.54 (64.71)
60 min	0.40 (87.58)	0.15 (62.50)	0.06 (84.21)	0.25 (83.66)

Hydrogen cyanide: Effects of boiling, roasting and autoclaving on hydrogen cyanide of raw vegetable cowpea (akidi) are shown in Table 2. Boiling and autoclaving for 60 min were found to be highly effective in reducing the HCN by up to 81.25 and 87.58% respectively. The reduction of hydrogen cyanide due to both boiling and autoclaving may be as a result of the fact that free cyanide and bond cyanide are both water soluble and hence may be leached out during boiling and autoclaving. A significant loss of HCN content (62.5%) was observed in the vegetable cowpea (akidi) by roasting for 120 min. The heat treatment involved in the process must have caused the vaporization of the free cyanide.

Oligossaccharides: As can be observed in Table 2, autoclaving at 60 min. has the highest reduction effect on the level of oligossaccharides. Similarly, boiling at 60 min. also indicated significant losses of raffinose (60.52%) and stachyose (67.97%). The decrease in the levels of oligossaccharides due to boiling might be attributed to heat hydorlysis of the oligossaccharides with the formation of simple disaccharides and monosaccharide (Oligbinde and Akinyel, 1983).
The decreasing effect of roasting on the Oligossaccharides are clearly shown in Table 2. The heat treatment applied may be responsible for the observed decrease in the Oligossaccharides. Maximum reduction of raffinose (84.21%) and stachyose (83.66%) contents occurred with autoclaving at 60 min.

Conclusion: Generally, it was observed that increasing boiling, roasting and autoclaving time of vegetable cowpea had progressive significant decrease on the antinutritional factors of the vegetable cowpea seeds.

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