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EFFECT OF PROCESSING ON ANTINUTRITIONAL FACTORS IN EDIBLE SEEDS OF KERSTINGS GROUNDNUT (*KERSTINGIELLA GEOCARPA* HARMS.)

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Summary

The effects of oven heating, autoclaving and boiling in water, on antinutritional factors, namely tannin, haemagglutinins and phytate contents in edible seeds of kerstings groundnut or groundbean (*Kerstingiella geocarpa* Harms.; Syn *Macrotyloma geocarpa* Harms.; Marechal & Baudet) were evaluated. Results show an important decrease in concentration of the antinutrients. Oven heating at 100 °C for 60 min had no significant ($P<0.05$) effect on the antinutritional constituents of kerstings groundnut meal. Autoclaving at 1.05 kg pressure and 121°C for 30 min destroyed most of the tannin and haemagglutinating activity and had no significant ($P<0.05$) effect on the phytate content. The best treatment was boiling for 30 min of the seeds presoaked in distilled water for 12 h at 27 °C which significantly ($P<0.05$) reduced tannin content by 98% haemagglutinating activity by 100% and phytate level by 70% compared to the untreated control. The presence of antinutritional factors identified in the present study should not reduce the biological value of dietary proteins if the seeds are properly processed by presoaking and boiling in water.

Introduction

Protein malnutrition is a serious problem for a large segment of the population in Nigeria and other developing countries conditioned by lack of protein of adequate quantity and quality in their diets. Unsuccessful attempts made by nutritionists around the world to approach this complex problem were developing novel foods such as algal protein, single-cell protein, insect protein and leaf protein concentrates (Altshul, 1974; Birch, Parker & Worgan, 1975; Lin *et al.* 1983; Hobman, 1991; Huffman 1996). Consequently, the malnutrition crisis has prompted a revival of interest in food legumes that the search for high-quality, inexpensive sources of protein has continued to be a major concern of agriculturists and government bodies working to provide adequate food and nutrition in most developing countries. A possible alternative to these situations is the utilization of edible seeds of kerstings groundnut or groundbean (*Kerstingiella geocarpa* Harms.; Syn *Macrotyloma geocarpa* Harms., Marechal & Baudet) which is a protein-rich food legume that has not been used to an important extent by the human population because its nutritional importance has not been fully determined. This crop is indigenous to tropical Africa and a promising alternative source of high-quality protein for food and feed for the tropics (Duke, Okigbo & Reed, 1977; Obasi & Ezedinma, 1991; Obasi & Agbatse, 1994). At present, kerstings groundnut is grown as a minor crop in the Savanna areas of West Africa, particularly, in Nigeria, Mali, Burkina Faso, Niger, Benin and Togo republics and is eaten boiled or ground into a paste for making food preparations like *moi-moi* (steamed paste food) or *akara* (fried paste food) in a manner similar to the consumption of cowpea or the seed flour used as soup thickners, particularly, by low-income groups. A factor which could limit the acceptance of kerstings groundnut seeds for wider utilization is undoubtedly the presence of antinutritional factors such as phytate, tannins and haemagglutinins which reduce the biological value of dietary proteins and hinder mineral absorption from the diet (Sathe & Salunkhe, 1984; Nolan & Duffin, 1987; Southern *et al.* 1990). However, published information on the antinutritional

characteristics of kerstings groundnut seeds is unavailable.

This paper reports the quantitative analysis and detoxification procedures of antinutritional factors of kerstings groundnut edible seeds so that the full potential of the seed proteins may be widely exploited for food and feed.

Experimental

Kerstings groundnut crop is a legume belonging to the family Leguminosae of the sub-division Papilionoideae. It is a prostrate herbaceous annual plant that has a subterranean habit of pod formation similar to peanut (*Arachis hypogeae* L.) Samples of mature seeds were obtained from 1993 harvests stored in the Department of Crop Production, University of Agriculture, Makurdi, Nigeria.

Sample preparation

Seeds of kerstings groundnut cv. NSK 1 were air dried and ground to fine powder in a Thomas-Willey mill, model 4, to pass 40 mesh and stored in polythene bags at 4 °C and withdrawn as required for analysis done on four replications in 1994.

Oven heating

Kerstings groundnut meal was heated at 100 °C for 60 min in a hot air oven and then cooled to 23°C

Autoclaving

Kerstings groundnut meal was placed in a conical flask as a layer (3 mm) autoclaved in a portable universal electric model pressure steam sterilizer (Arnold & Sons, Basildon Limited, U.K.) at 1.05 kg pressure and 121°C or 30 min and then cooled to 23 °C

Boiling in water

Seed samples were soaked in distilled water (1:20 W/V) for 12 h at 27 °C, boiled in water (1:10 W/V) for 30 min and later dried at 60 °C. The seeds were ground to fine powder.

Phytate determination

The determination was done according to the method of Thompson & Erdman (1982) and iron content was measured on a Perkin Elmer 503 atomic absorption spectrophotometer.

Tannin analysis

Tannin was determined by the method described by Swain & Hills (1959).

Haemagglutinins

Kerstings groundnut seed extract was prepared by extracting 100 mg of sample with 5.0 ml of 0.005 *M* NaOH for 3 h with mechanical shaking at 27 °C. The haemagglutinating activity of the extract was determined according to the method described by Fernandez *et al.* (1982).

Statistical analysis

An analysis of variance using the test of Duncan (1955) was applied to tannin, phytate and haemagglutinins data.

Results and discussion

The effect of processing shows an important decrease in the antinutritional contents in edible seeds of kerstings groundnut (Table 1). Oven heated seeds had a 6 per cent lower tannin content compared to the control, whereas autoclaving treatment significantly ($P<0.05$) decreased tannin content by 57 per cent Boiling presoaked seeds for 30 min significantly ($P<0.05$) reduced the level of tannin by 98 per cent. The loss of tannins resulting from the various heat treatments could be attributed to either reduced extractability, actual removal or change in chemical reactivity which are in agreement with the views of Barroga, Laurena & Mendoza (1985). Seeds boiled in water reflected the lowest and negligible content of tannin (0.09 ± 0.02 mg g^{-1}) likely due to more leaching into water during boiling. Similar losses of tannin (Salunkhe & Kadam, 1989; Kaur & Kapoor, 1990; Chang *et al.* 1994) during soaking and cooking in water have been reported for different legume seeds. Tannins affect adversely protein digestibility (Sathe & Salumkhe, 1984). Studies show that tannins in legume seeds are mostly located in the seed coat with only traces in the cotyle-

TABLE 1
*Effect of processing on antinutritional contents in kersing's groundnut seed**

Treatment	*Antinutitional contents* *Tanning (mg g^{-1})*	*Haemagglutinating activity (units mg^{-1})*	*Phytate (mg g^{-1})*
Oven heating	5.1± 0.12a (6)	93±1.8a (9)	3.98±0.03a (1)
Autoclaving	2.3± 0.09b (57)	4±0.4b (96)	3.81±0.04a (5)
Boiling in water	0.09± 0.02c (98)	ND (100)	1.21±0.02b (70)
Control (untreated seeds)	5.54± 0.18a	102± 2.9a	4.01±0.01a

* Values, means ± SD of four indenpendent determinations.
Figues in parenthesis represent reduction in antinutritional content expressed as percentage of control values.
ND = not detected.
a-c = Mean values in the same column with different letters were significantly different ($P< 0.05$).

dons. Since the seed coats in kerstings groundnut are usually removed by soaking and washing prior to boiling and consumption, its negligible tannin content as evident from the present study, may be considered to be of no significance from the nutritional viewpoint.

The haemagglutinating activity in kerstings groundnut seeds was not significantly ($P<0.05$) reduced by the oven heating treatment compared to the control. Similar resistance of haemagglutinins to inactivation by dry heat treatments has been reported earlier (DeMuelenaeve, 1964; Kaul & Bajwa, 1987). On the contrary, autoclaving was significantly ($P<0.05$) effective in destroying most of haemagglutinating activity in kerstings groundnut meal, whereas, no detectable level of haemagglutinating activity was observed in boiled seeds over that of the control. Studies reveal that moist heat treatment before legume grains are used in the human diet improves protein quality by inactivating antiphysiological factors, particularly haemagglutinin and trypsin inhibitor, and by unfolding the protein structure, makes them more susceptible to attack by digestive enzymes (Sathe, Desphende & Salunkhe; 1984; Lopez Schevenin & Lara, 1989). Results of the present study imply that boiling presoaked seeds enhances seed protein utilization for human nutrition.

The high phytate level in kerstings groundnut seeds (4.01 ± 0.01 mg g^{-1}) is of nutritional significance. Phytate, widely distributed in mature legume and cereal grains stores most of the grain phosphorus and is not digested by humans. Besides, phytate lowers the bioavailability of minerals (Reddy, Sathe & Salunkhe, 1982; Nolan & Duffin, 1987) and inhibits proteolytic (Singh & Krikorian, 1982; Serraino *et al.* 1985) and amylolytic (Yoon, Thompson & Erdman 1983; Deshpande & Cheryan, 1984) digestive enzymes. The results (Table 1) show that oven heating and autoclaving treatments had no significant ($P<0.05$) effect on the phytate contents in kerstings groundnut seeds as compared to the untreated control. Conversely, the phytate content was significantly ($P<0.05$) lowered by presoaking and boiling in water. The decrease in the level of phytate may be attributed to leaching out of this antinutrient into water under the influence of concentration gradient. Such losses may be taken as a function of changed permeability of seed coat. Soaking, an integral part of traditional methods of processing kerstings groundnut seeds in Nigeria, thus offers the dual advantage of reducing energy cost by shortening cooking time as well as rendering the seeds nutritionally superior by greatly reducing the phytate content. Sig-

nificant losses of phytate content during soaking have been reported in moth bean and mungbean (Khokhar & Chauhan, 1986; Abdus *et al.*, 1989) and cowpea, lima bean and soybean (Ologhobo & Fetuga, 1984; Barampama & Simard, 1994).

Since the antinutrient contents in the edible seeds of kerstings groundnut can be greatly reduced by common domestic methods of presoaking and boiling in water, it is suggested that the seeds can be useful as a food protein source and that the seed merits wider use in Nigeria and other developing countries.

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