African Journal of Biotechnology Vol. 9(8), pp. 1200-1204, 22 February, 2010
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2010 Academic Journals

Full Length Research Paper

Effect of processing on iodine content of some selected plants food

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Accepted 28 December, 2009

Effect of processing on iodine content of some selected plants food was investigated. Results show significant reduction ($p < 0.05$) in the iodine content of the processed food compared with the raw forms. The iodine value of 658.60 ± 17.2 µg/100g observed in raw edible portion of *Discorea rotundata* was significantly higher compared with the value of 448.60 ± 2.46, 248.60 ± 2.46 and 300.05 ± 5.66 µg/100g dry matter observed in the boiled yam, pounded yam and yam flour, respectively. The result also indicates that the iodine value of 592.50 ± 8.22 µg/100g dry matter observed in the raw form of cassava was higher when compared with that of garri (366.03 ± 3.82 µg/100g) and cassava flour (216.90 ± 1.03 µg/100g dry matter). Similarly, raw Z*ea mays* contain higher iodine (112.24 ± 0.42 µg/100g) compared with boiled maize (79.44 ± 0.64 µg/100g dry matter) and fresh ogi (45.07 ± 1.24 µg/100g dry matter). The result also indicates that raw *Vigina uguicnlata* and *Arachis hypogea* contain higher iodine content (112.22 ± 0.22 and 119.62 ± 0.22 µg/100g dry matter, respectively) when compared with their boiled forms (97.33 ± 1.53 and 83.12 ± 1.35 µg/100g, respectively). Results obtained in this study thus indicate that processing significantly reduces iodine content of food products, hence consideration must be given to different processing methods when accessing Iodine intake from different processed foods.

Key words: Processing, iodine content, food products, fermentation, boiling, roasting.

INTRODUCTION

Iodine is an essential trace element of great importance in human nutrition. The element is an integral part of the thyroid hormones (Dunn and Dunn, 2001). Recommended daily allowance of dietary iodine is 180-200 µg for adults, > 100 µg for children and the daily intake during pregnancy should be at least 230 µg iodine (Horst et al., 2005). As iodine is essential for normal brain development (Delange, 2000), it is particularly important that the foetus and young children have adequate intakes (Venturi et al., 2000).

The term iodine deficiency disorder is used to describe the wide range of effects low iodine status can have on health. Iodine deficiency disorders due to iodine decrease or loss during processing or cooking is still a major public health problem in several areas of the world, especially in developing countries (Ozdemir et al., 2009; Wisnu, 2008). One of the serious health effects of iodine deficiency disorders is goiter (Roti and Uberti, 2001; Rasmussen et al., 2002). In very severe iodine deficiency, stunted growth and mental retardation can occur in children (Laurberg, 2004). A number of studies have reported adverse effects on hearing capacity, motor and cognitive function in children associated with moderate and severe iodine deficiency (Venturi et al., 2000; Ruwhof and Drexhage, 2001; Mann and Aitken, 2003).

Food processing is one of the earliest technologies that man has been using. It has the advantage of insuring food supply and in many cases as a necessary step before consumption for a variety of reason, such as increasing stability, improving flavour, decreasing possibility of toxicity and introducing functioning ability.

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Some of these processing methods are fermentation, frying and cooking (Raghuuath and Belavady, 1997; Prablivathi and Narasinga, 1979). These processing also introduce chemicals that affect nutritional values adversely. Certain food processing practices often increase the amount of iodine in foods. For example, the addition of potassium iodide to table salt to produce "iodized" salt has dramatically increased the iodine intake of people in developed countries (Clark et al., 2002; Diosady et al., 1997). In addition, iodine-based dough conditioners are commonly used in commercial bread-making, which increases the iodine content of the bread (Connolly et al., 1970). When in elemental form iodine readily sublime and is then rapidly lost to the atmosphere (Laurberg, 2004), its iodate form such as potassium iodate can be reduce to elemental iodine by a variety of reducing agents (Diosady et al., 1997). The absorption and/or utilization of iodine are inhibited by components of certain foods. These food components, called goitrogenic compounds, are found primarily in cruciferous vegetables (for example, cabbage and broccoli), soybean products, cassava root, peanuts, mustard, and millet. Over consumption of these foods may lead to thyroid problems by reducing the amount of available iodine for the manufacture of thyroid hormones (Kontras et al., 2002; Soetan, 2008). It is believed that cooking can inactivate the goitrogenic compounds in these foods, thereby eliminating their negative impact on iodine status (Kontras et al., 2002).

In our previous study, we reported on the iodine content of some tubers, fruit and vegetables locally grown and consume in Ijebu North Local Government Area of Ogun State, Nigeria (Salau et al., 2008). Till date, very few studies have been conducted to assess the losses of iodine during cooking procedures. As with most chemical reactions, an increase in temperature (as encountered in cooking and drying) increases rate of reaction that forms elemental iodine and increase its evaporation rate. In light of the above we set to investigate effect of some local processing methods on iodine content of some selected plants food grown and consumed in Ijebu-North local government of Ogun state, Nigeria.

MATERIAL AND METHODS

Sample collection

Yam, cassava tubers, maize, cowpeas and groundnuts were purchase from two major markets in Ijebu-Igbo and Ago-Iwoye in Ijebu-North Local government. Six samples, from each market were purchased randomly. The sample weight varied between 1-5 kg. The six samples for each product were thoroughly mixed together.

Sample preparation

Yam

The edible portion was prepared by cleaning the dirt with water and removing the peel with knife. The moisture and iodine content was then determined. The edible portion was further cut into pieces and later divided into six portions for moisture and iodine content determination. The first two (2) portions were mixed together and boiled. The data generated from this was recorded for boiling. The other two (2) portions were first boiled and used for pounded yam. The last two (2) portions were used for yam flour following the method of Song (1992).

Cassava

The edible portion was also prepared as described for yam. Two other portions were mixed together and used for cassava flour (lafun). The last two portions were used for cassava meal (garri). The garri was prepared using local method. The edible portion was first grated, dewatered, fermented, sieved and then fried (Song, 1992).

Maize

The maize was cleaned and washed in water. 100 g of sample was collected from each portion for moisture and iodine content determination. They were later divided into six portions. Three (3) portions each were mixed together into two parts. One part was boiled and the other part used for ogi following local methods as described by Augustine (1991).

Cowpea and groundnuts

Edible portions were prepared by cleaning and washing with water. The portions were later divided into two parts. One part was used as raw sample while the other part was boiled in water. Samples were collected in six replicate for each analysis

Sample analysis

Moisture Content

Thirty (30) g of each sample were taken (6 replicate) into 200 ml crucible, dried in an oven at 105°C for 24 h and moisture content was thereafter determined.

Ashing

Five (5) g of each dried sample was pulverized using mortar and pestle. Two (2) g of powdered sample was taken and placed in ash crucible. They were then mixed with five (5) g of Na_2CO_3, 5 ml of 0.5 M NaOH and 10 ml ethanol. The sample was placed in the steam bath at 100°C for about 20 min and later transferred to carbolite furnace for about 15 min at 500°C.

Iodine content

The iodine content was analysed according to Elmsie Caldwells methods as modified by Diosady and Fitzgerald (1983).

Statistics

The experimental design was completely randomized. Data were analyzed using the SPSS. Significant difference between the data was determined at $p < 0.05$ using Duncan multiple range test.

Table 1. Iodine content of yam and its products.

Yam and its Products	Moisture content (g %)	Iodine content (µg/100g dry matter)	% difference in iodine content
Fresh yam (edible portion)	68.80 ± 0.20	658.65 ± 17.26[a]	Not determined
Roasted yam	24.60 ± 0.09	592.48 ± 5.82[b]	-9.94
Boiled yam	74.91 ± 2.31	448.60 ± 2.46[c]	-31.89
Yam flour	12.00 ± 1.68	307.40 ± 3.66[d]	-53.33
Pounded yam	64.53 ± 1.82	248.60 ± 2.16[e]	-62.26

Values are expressed as mean of 6 determinations ± SEM.
Values in the same column with thee same superscript are not significantly different from each others.

Table 2. Iodine and Moisture content of cassava (*Maintial esculena*) and its products.

Cassava and its product	Moisture content (g %)	Iodine content (µg/100g dry matter)	% difference in iodine content
Fresh cassava tuber (edible portion)	58.25 ± 1.18	592.50 ± 8.22[a]	Not determined
Cassava flour (lafun)	14.15 ± 0.22	216.90 ± 1.23[b]	-63.39
Cassava meal (garri)	18.32 ± 0.38	366.03 ± 3.82[c]	-38.22

Values are expressed as mean of 6 determinations ± SEM.
Values in the same column with the same superscript are not significantly different from each others.

Table 3. Iodine and iodine content of maize (Z*ea maize*) and its product.

Maize and its products	Moisture content (g %)	Iodine content (µg/100g)	% difference in iodine content
Dry maize (edible portion)	0.05±0.88	112.24±1.42[a]	Not determined
Boiled maize	51.01±1.23	79.44±2.64[b]	-29.22
Ogi	66.04±1.21	45.01±1.23[c]	-59.90

Values are expressed as mean of 6 determinations ± SEM.
Values in the same column with the same superscript are not significantly different from each others.

RESULT

Shown in Table 1 is the result of the moisture and iodine content of yam and yam products. Iodine content of all the processed products were significantly ($p < 0.05$) lowered than the raw food. The least reduction (9.94%) was observed in roasted yam, while the highest reduction (62.26%) was observed in pounded yam. The result of moisture and iodine content of cassava and its products is shown in Table 2. The two processed products were significantly lowered ($p < 0.05$) in iodine content when compared with the raw edible portion. The least reduction in iodine content was observed in garri (38.22%) while lafun has the highest reduction (63.39%)

Table 3 is the result of the moisture and iodine contents of maize and its products. Boiling of maize and processing to ogi was observed to significantly reduce the iodine content when compared with the raw edible portion. Highest loss of iodine (59.90%) was observed in ogi whereas as a percentage iodine reduction of 29.22% was observed in the boiled maize.

The result of the moisture and iodine content of cowpea and groundnut (raw edible portions and their products) are shown in Table 4. The result indicates that boiling significantly reduced iodine content by 29.95% in cowpea and 18.63% in groundnut. No significant difference was observed between the iodine content of raw groundnut and cowpea whereas the iodine content of boiled groundnut was significantly higher than that of the boiled cowpea.

No significant correlation was observed between the iodine content and moisture content of all the products.

DISCUSSION

The iodine content of foods is generally reflective of background levels as well as processing technology and manufacturing practices. For example, the high iodine content of milk and dairy products has been attributed to the use of iodine-containing supplements in feed for dairy cattle, iodophor-based medications, teat dips and udder washes as well as iodophors used as sanitizing agents in

Table 4. Iodine and Moisture content iodine content of cowpea (*Vigina uguiculata*), groundnut (*Arachis hypogea*) and their products.

Raw processed form	Moisture content (g %)	Iodine content (µg/100g)	% difference in iodine content
Raw cowpea (edible portion)	11.15 ± 1.33	112.22 ±1.25[a]	Not determined
Boiled cowpea	55.46 ± 2.92	83.12± 1.35[b]	-29.93
Raw groundnut edible portion	21.12 ± 1.30	119.62±3.11[a]	Not determined
Boiled groundnut	61.21 ± 2.48	97.33±1.54[c]	-18.63

Values are expressed as mean of 6 determinations ± SEM.
Values in the same column with the same superscript are not significantly different from each others.

dairy processing establishments (Fischer and Giroux, 1987; Park et al., 1981; Pennington et al., 1986). The elevated iodine levels found in grain and cereal products are related to endogenous iodine in ingredients but, in addition, likely reflect the use of iodine-containing food additives, such as iodate dough conditioners (Varo et al., 1982; Katamine et al., 1986).

In the present study, the major processing methods used were boiling, frying, drying and fermentation. The study indicates that fermentation leads to the greatest loss in iodine content as observed in yam (53.3%), cassava flour (63.39%) and ogi (59.90%). The reduction could be attributed to leaking of iodine into the soaking water and also possibly by evaporation especially during drying of yam and cassava flour. This is in agreement with previous study which reported reduction in certain nutrients during fermentation and drying (Binita and Khetarpaul, 1997; Varo et al., 1982; Nelson and Philip, 1985).

Few older studies with rather inconsistent results exist on the influence of household preparations and processing on the iodine content of foods (Manthey, 1989; Varo et al., 1982; Montag and Grote, 1981). Manthey et al. (1989) found an increase of iodine after cooking and frying of saithe portions of fish, whereas Montag and Grote (1981) reported a considerable decrease in the iodine content after household preparation of plaice and haddock. Our study indicates that cooking reduced iodine content of roasted yam by 10.04%, whereas boiling reduced the iodine content of yam by 31.89%, maize by 29.22%, cowpea by 29.93% and groundnut by 18.63%. Our result indicates a percentage reduction in iodine content that varies from 18.63 to 31.89% as a result of roasting and boiling. The difference observed may be due to differences in cooking time and the nature of plant material. In a previous study, it was reported that roasting of meatballs for 15 min resulted in a 5% loss of iodine. Extension of thermal requirement to 30 min resulted in an increase, almost threefold, of iodine loss (Ozdemir et al., 2009). The same study also reported that the decrease of iodate content and conversion to other iodine species is affected by acidity, moisture content, heating during cooking process and is also influenced by the type of cooking spices and raw materials used.

The observed difference in iodine content between the boiled and pounded yam could be attributed to the release of iodine during pounding.

Conclusion

The result of this study indicates that local processing method reduced iodine content of the selected plant food grown and consumed in Ijebu-north Local Government Area of Ogun State, Nigeria. Though root and tuber contain high level of iodine, the final content at consumption stage is very low. Thus, improved method of processing of the local plant food available in this area in order to ensure that the dietary requirement of iodine is met by people leaving in this area is met may be advocated.

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