

Quality Evaluation of Cocoyam (Eddoe) Crisps Produced under a Farm Condition in Nigeria

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Abstract: Cormels of Eddoe type of cocoyam were used to produce fried crisps (salted, sugared, salted/sugared and natural) under a farm condition in Nigeria. In addition to the physical analysis of the Eddoe crisps, the experimental raw materials and crisps were subjected to relevant chemical analysis. A sensory evaluation panel was also used to assess the organoleptic characteristics of the fresh and stored (packaged) crisps. Results showed that the 1.0-1.5mm thick circular crisps had mean fat content of 7.85%. While all the fresh experimental Eddoe crisps samples (with creamy-brown to brown colour) were generally acceptable (by the sensory assessors), the natural crisps samples were not generally liked after one week of storage. Interestingly, table salt (NaCl) was found to have the potential of extending the shelf life of this local novel snack food to 3 weeks, at ambient room temperatures (26-32°C).

Key words: Cocoyam, crisps, quality evaluation, novel snack food, Nigeria

INTRODUCTION

According to Onwueme (1978) cocoyams in Africa can be grouped into *Xanthosoma sagittifolium* (new cocoyam or tannia) and *Colocasia esculenta* (old cocoyam or taro). *Colocasia, esculenta* could also be subdivided into *C. esculenta* var. *esculenta* or dasheen and *C. esculenta* var. *antiquorum* or Eddoe (Onwueme, 1978). In most cases, the edible tuberous portions of dasheen and Eddoe are the corms and cormels respectively (Onwueme, 1978; Rehm and Espig, 1991).

Over the centuries, *C. esculenta* had served as staple food for indigenes of the West Coast of Africa and their relatives in the Americas especially in the West Indies. Historically, most of the Africans transported to the Americas during the slave trade era of the 15-19th century, were from the West Coast of Africa (Fage, 1969; Isichei, 1972; Dike and Ekejiuba, 1990) and *C. esculenta* was considered to have been transferred to the Americans during this period (Coursey, 1968). Infact, the vernacular name for old cocoyam (*C. esculenta* var. *antiquorum* [L.] Schott) amongst the populous Ibo (Igbo) tribesmen of South-eastern, Nigeria, West Africa is 'ede'. Their neighbouring Yoruba tribesmen (also living along the West Coast of Africa) use 'koko' as the vernacular name for all varieties of cocoyam.

Farm-gate or rural level processing of cocoyam into a snack food that is acceptable by local consumers has

the potential of enhancing the crops production and popularity (Agueguia, 2000; Matthews, 2000). Unlike potato (*Solanum tuberosum*) and edible yams (*Dioscorea* sp.), the taste of the edible portions of many cocoyam cultivars is known to be acrid (Coursey, 1968). However, Ukpabi and Ejidoh (1989) identified crisps made from the cormels of Cocoinidia cultivar of Eddoe (*C. esculenta* var. *antiquorum*) as having the least itching potential amongst the fried crisps made from the local cocoyam cultivars in the germ plasm of National Root Crops Research Institute (NRCRI), Umudike, Umuahia, Abia State, Nigeria.

Crisps or chips, made by deep oil frying of potato slices are popular snack foods in United States of America and Western Europe (Smith, 1977; Burton, 1989). This work is aimed at producing acceptable crisps from cocoyam (Eddoe) using technologies that are adaptable by the resource poor farmers and rural food processors in Nigeria. Due to the fact that potato crisps are now available in Nigeria urban markets, knowledge of certain quality characteristics of the local Eddoe crisps is necessary for consumers' assurance of this novel snack food in the country.

MATERIALS AND METHODS

Sources of materials: Cormels of Cocoinidia cultivar of Eddoe (*C. esculenta* var. *antiquorum*) used for this study were harvested from the experimental plots of Cocoyam

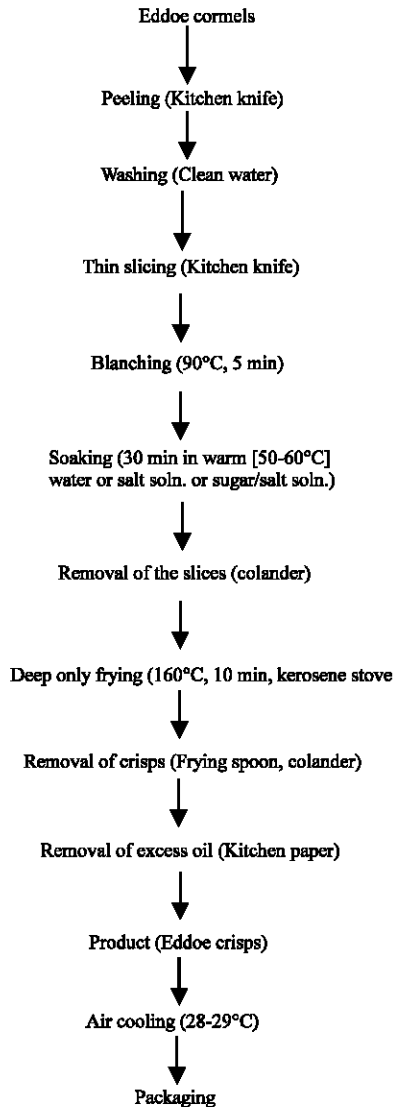


Fig. 1: Flow-chart for the Eddoe (cocoyam) crisps production

Programme, NRCRI, Umudike, Abia State, Nigeria in December, 2003 to January, 2004. Refined palm oil (Turkey brand), table salt (Dangote brand) and granulated cane sugar (St. Louis brand) were purchased at Umuahia Main Market, Abia State, Nigeria. The small kerosene stove (T-wheel Brand) used for heating, was also purchased at the same market.

Preparation and storage of the Eddoe crisps: Figure 1 shows the flow-chart for the production of crisps from the white fleshed cormels of *Cocoinidia* cultivar of Eddoe. Four different types of crisps (salted, sugared, simultaneously salted and sugared and plain) were obtained after the blanching stage (or operation) by

soaking the sliced cormels in 1% salt (sodium chloride) solution, 2% sugar (sucrose) solution, 1%NaCl + 2% sucrose solution and water respectively. Approximately 100g of the air-cooled crisps, wrapped in aluminum foil and packed in heat sealed polyethylene bags were stored at ambient room temperatures (26-32°C) in a wooden cabinet for four weeks. All these processing and storage activities took place in the rural farmstead of NRCRI, Abia State, Nigeria in February to March, 2004.

Chemical analysis: Proximate composition of the experimental peeled cormels was determined in quadruplicate by standard methods (AOAC, 1997). The AOAC (1997) method was also used to determine the mean fat content of the crisps and the peroxide values of randomly selected fresh and stored crisps samples.

Physical analysis: Colour of the crisps was determined visually while a ruler was used to determine the thickness and diameter of the circular Eddoe crisps.

Sensory evaluation

Fresh crisps: Twenty semi-trained assessors were used to evaluate the organoleptic characteristics of the freshly prepared salted, sugared, salted/sugared and plain crisps using a 7-point Hedonic scale (Bainbridge *et al.*, 1996; Iwe, 2002). In this scale, 1 = dislike extremely, 4 = neither like nor dislike, 7 = like extremely. The sensory parameters evaluated were colour, taste, crispness and general acceptability.

Stored samples (1-4 weeks): Each type of the Eddoe crisps, had its stored crisps further evaluated for colour, flavour and crispness by the sensory evaluation panelists. The 7-point Hedonic scale used for the fresh samples was also used for the evaluation.

Statistical analysis: Statistical Analysis System (SAS) PC Software (License site 0022206002 of International Institute of Tropical Agriculture, Ibadan, Nigeria) was used for the mean separations and other statistical analysis.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of the peeled cormels used for the production of the cocoyam (Eddoe) crisps. The mean moisture content of the carbohydrate rich cormels was 69.84% while the protein content was 5.87% on dry matter basis. In a similar trial on crisps (or chips) production in Australia, the moisture content of the taro raw material was 57.8-74.9%

Table 1: Proximate composition of the peeled fresh cormels of Cocoidia cultivar of Eddoe (*C. esculenta* var. *antiquorum*)

Nutrient	Percentage content*
Dry matter	30.16
Moisture	69.84
Crude protein	1.77 (5.87)
Fibre	0.72 (2.40)
Fat	0.15 (0.48)
Ash	0.98 (3.25)
Carbohydrates	26.54 (88.50)

* Values in bracket were calculated on dry matter basis

Table 2: Sensory evaluation scores[#] for the fresh products

Treatment	Scores [#]			
	Colour	Taste	Crispness	General acceptability
Sugared	5.06 ^a	5.19 ^a	5.06 ^a	5.56 ^{ab}
Salted	5.31 ^a	5.31 ^a	5.81 ^a	6.00 ^a
Salted/sugared	5.75 ^a	5.75 ^a	5.69 ^a	5.88 ^a
Natural	5.00 ^a	4.94 ^a	4.63 ^a	4.63 ^b

Where 1 = dislike extremely; 4 = neither like nor dislike; 7 = like extremely. *Values with the same letter in a column do not differ significantly (p = 0.05)

(O' Keefe *et al.*, 2005). The dimensions of the circular shaped fried crisps obtained in our study were 2.0-3.5cm diameter and 1.0-1.5 mm thickness. The thickness of our crisps is also similar to 1.5-1.75 mm recorded by O' Keefe *et al.* (2005) for taro crisps that were acceptable by Australian consumers. The observed colour of our experimental crisps (made from white fleshed Eddoe) varied from creamy brown to brown. Non enzymatic browning reactions are known to cause this kind of discolouration in thermally processed tropical roots and tubers (Okaka and Okaka, 2001; Onimowo and Akubor, 2005). It was also observed that the sugared crisps had darker edges while the plain or natural crisps were largely creamy in the central regions. Onimowo and Akubor (2005) wrote that the reducing sugar and ascorbic acid contents of food raw materials may enhance certain types of non enzymatic browning. O' Keefe *et al.* (2005) specifically showed that higher sugar content in the taro raw material, used for their crisps production, gave darker brown colour. Earlier recorded reducing sugar and ascorbic acid contents of edible portions of taro were 0.52 g 100g⁻¹ (Coursey, 1968) and 7-14mg 100g⁻¹ (Coursey, 1968; Oyenuga, 1968), respectively.

The sensory evaluation results for the fresh fried crisps are shown in Table 2. Though the sensory assessors generally liked all the four types of cocoyam crisps, the salted samples were seemingly preferred over the unflavoured crisps (Table 2). Even in Australia, salting (though added after frying of the chips) enhanced consumers acceptability of taro crisps (O' Keefe *et al.*, 2005). Sensory evaluation of the packaged and stored crispy snack food samples (Table 3-6) show that only the flavoured (salted and sugared) crisps samples were

Table 3: Sensory evaluation scores[#] of stored salted edddoe crisps

Duration (wks)	Scores*		
	Colour	Flavour	Crispness
1	5.60 ^a	5.40 ^a	6.00 ^a
2	5.60 ^a	5.40 ^a	5.40 ^a
3	5.20 ^a	5.2 ^{ab}	5.40 ^a
4	4.60 ^a	4.00 ^b	3.40 ^b

** As in Table 2

Table 4: Sensory evaluation scores[#] of stored salted/sugared Eddoe crisps

Duration (wks)	Scores*		
	Colour	Flavour	Crispness
1	5.6 ^a	5.0 ^a	5.4 ^a
2	5.6 ^a	-	5.0 ^a
3	5.2 ^{ab}	5.2 ^a	5.0 ^a
4	4.4 ^b	3.8 ^b	4.0 ^b

** As in Table 2

Table 5: Sensory evaluation scores[#] of stored sugared Eddoe crisps

Duration (wks)	Scores*		
	Colour	Flavour	Crispness
1	5.0 ^a	5.40 ^a	5.60 ^a
2	5.4 ^a	4.4 ^a	5.20 ^a
3	5.4 ^a	4.8 ^a	5.20 ^a
4	4.8 ^a	3.0 ^b	4.00 ^b

** As in Table 2

Table 6: Sensory evaluation scores[#] of stored natural Eddoe crisps

Duration (wks)	Scores*		
	Colour	Flavour	Crispness
1	-	3.6 ^a	4.2 ^{ab}
2	5.6 ^a	4.2 ^a	-
3	5.0 ^{ab}	3.6 ^a	4.4 ^a
4	4.4 ^b	2.8 ^b	3.6 ^b

** As in Table 2

generally liked (for colour, flavour and crispness) up to 3 weeks of storage. The consumer acceptability of the stored natural or plain crisps cannot be guaranteed even at 1 week of storage without food preservatives (Table 6). From the sensory panelists point of view, the flavoured crisps in this study should not have a shelf-life of more than three weeks (at 26-32°C).

The results of the peroxide value analysis for the randomly selected salted crisps were 3.0 and 5.7 milliequiv kg⁻¹ for the fresh and 4 wk old samples, respectively. In contrast, the figure obtained for the natural (unflavoured) crisps at 3rd wk of storage was 6.06 milliequiv kg⁻¹, while that for sugared crisps at 4th wk of storage was 6.20 milliequiv kg⁻¹. Though, the sum of peroxide and p-anisidine values are required to properly monitor the degree of oxidative deterioration in palm oil products (Coursey *et al.*, 1984), peroxide value is also indicative of the rate of rancidity in oil products (Onimowo and Akubor, 2005) such as the oil fried crisps. Expectedly, the fresh crisps samples, with experimental mean fat content of 7.85%, had lower peroxide values than the stored ones.

Table salt, Generally Recognized as Safe (GRAS) preservative (Heimann, 1980) helped in extending the shelf life of the packaged Eddoe crisps to 3 weeks.

CONCLUSION

Salted Eddoe crisps were preferred over plain Eddoe crisps by the organoleptic evaluation panelists. Salted and sugared types of cocoyam (Eddoe) crisps, wrapped in aluminum foils and packed in sealed polyethylene bags could store for a maximum of 3 weeks (at 26 to 32°C) and be acceptable to consumers. On the other hand, the plain crisps may not store for up to one week in the same packaging materials and temperatures. In absence of antioxidants used in industrial production of crisps (such as butylated hydroxyanisole and butylated hydroxytoluene that are considered as GRAS), resource poor farmers, food processors and chefs in Nigeria may be advised to use table salt to extend the shelf life of the crispy novel Eddoe food at ambient room temperatures.

REFERENCES

- Agueguia, A., 2000. Importance and Uses of Cocoyam in Cameroonian Diets. In: Potential of Root Crops for Food and Industrial Resources (Nakatani, M. and Komaki, K. Eds.), 12th Symp. Int. Soci. Trop. Root Crops, Tsukuba, Japan, pp: 512-514.
- AOAC. 1997. Official Methods of Analysis of Association of Official Analytical Chemists (William, H. Ed.), Washington D.C.
- Bainbridge, Z., K. Tomlins, K. Wellings and A. Wesby, 1996. Methods of Assessing Quality characteristics of Non-Grain Starch Staples. Part 4-Advanced Methods. Natural Resources Institute, Chatham, U.K.
- Burton, W.G., 1989. The Potato. (3rd Edn.), Harlow, Essex, England: Longman.
- Coursey, D.G., 1968. The Edible Aroids. *World Crops*, 20: 25-30.
- Coursey, D.G., N. Macfarlane and A.A. Swetman, 1984. Comparison of traditional and industrial palm oil. *Oil Palm News*, 28: 11-17.
- Dike, K.O. and F. Ekejiuba, 1990. The Aro of South-eastern Nigeria, 1659-1980. University Press Ltd, Ibadan, Nigeria.
- Fage, J.D., 1969. A History of West Africa. University Press, Cambridge, England.
- Heimann, W., 1980. Fundamentals of Food Chemistry Ellis Horwood, Chichester, England.
- Isichei, E., 1972. Igbo World. An Anthology of Oral Histories and Historical Descriptions. Macmillan Education Ltd, London.
- Iwe, M.O., 2002. Handbook of Sensory Methods and Analysis. Rejoint Communications Services, Enugu, Nigeria.
- Matthews, P.J., 2000. An Introduction to the History of Taro as a Food. In: Potential of Root Crops for Food and Industrial Resources (Nakatani, M. and Komaki, K. Eds.), 12th Symposium of The International Society for Tropical Root Crops, Tsukuba, Japan, pp: 484-497.
- Okaka, J.C. and A.N.C. Okaka, 2001. Food: Composition, Spoilage, Shelf-life. Extension. OCJANKO Academic Publishers, Enugu, Nigeria.
- O'Keefe, V.G. Mason, A. Willis and G. Bell, 2005. Commercial Taro Chip Development using Agric-chain partnership. A processing, marketing and financial analysis. RIRDC Pub. No 05/144. Rural Industries Res. Dev. Corp., Barton, ACT, Australia. www.rirdc.gov.au
- Onimawo, I.A. and P.I. Akubor, 2005. Food Chemistry. Integrated Approach with Biochemical Background. AMBIK Press, Benin City, Nigeria.
- Onweme, I.C., 1978. The Tropical Tuber Crops. John Wiley, Chichester, U.K., pp: 199-225.
- Oyenuga, V.A., 1968. Nigeria's Food and Feeding-stuffs. The Chemistry and Nutritive value. Ibadan University Press, Ibadan, Nigeria, pp: 23.
- Rehm, S. and G. Espig, 1991. The Cultivated Plants of the Tropics and Subtropics. Cultivation, Economic Value, Utilization (English Edn.), Verlag Josef Megraf, Weikersheim, Germany.
- Smith, O., 1977. Potatoes: Production, Storing, Processing. AVI, Westport, Connecticut.
- Ukpabi, U.J. and J.I. Ejidoh, 1989. Effect of deep oil frying on the oxalate content and the degree of itching of Cocoyam (*Xanthosoma* and *Colocasia* sp.) 5th Annual Conference of Agricultural Society of Nigeria, Federal University of Technology, Owerri.