Effect of Treatments on the Quality Evaluation of Cocoyam Crisps and Chips

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ABSTRACT----- ***Cocoyam (Colocasia esculental) was processed and used in the production of crisps and chips by subjecting the peeled, washed and sliced cocoyam to four different pretreatments (plain-untreated, salted, sugared, salted/sugared). The proximate properties and sensory attributes of the crisps and chips were evaluated using plantain chips as the control. Proximate composition result showed that moisture, ash, fibre, fat, protein, fibre, fat and carbohydrate content of the cocoyam crisps ranged from 3.26 – 4.12% (samples A3 and A), 1.69 – 3.05% (A and A3), 6.15 – 9.47% (A and A3), 2.75 – 10.35% (A2 and A1), 9.25 – 11.76% (A2 and A) and 65.15 – 72.78% (samples A1 and A2), respectively. While result for cocoyam chips ranged from 4.17 – 9.55% (samples B1 and B), 2.93 – 4.62% (B and B2), 8.36 – 12.74% (B1 and B2), 2.21 – 7.55% (B3 and B1), 9.17 – 10.87% (B2 and B1) and 60.77 – 66.42% (samples B2 and B3), respectively. From the result, it was observed that moisture, ash, fat and carbohydrate values of plantain chips compared significantly (P<0.05) with some samples of cocoyam crisps and chips with the values of 4.51%, 2.62, 9.80 and 75.52%, respectively. Significantly low protein and fibre content of plantain chips was recorded (4.39 and 3.16%, respectively) compare to the values of crisps and chips produced from cocoyam. Sensory scores obtained from the parameters evaluated showed that both pretreated and untreated cocoyam crisps and chips were acceptable by the panelists compared to the control sample (plantain chips). Highest overall acceptability scores were recorded from samples A1, A2 and B3 (7.20, 7.40 and 7.30, respectively). This result is an indication that cocoyam can be pretreated with either salt, sugar or a combination of both and used in the production of crisps and chips with high level of market acceptability which will still provide proximate compositions comparable with that of plantain chips.***

Keywords--- Cocoyam, Crisps, Chips, Various Treatments, Proximate and Sensory Properties

1. INTRODUCTION

Deep fried snacks have a satisfying crunchy texture and a distinctive taste which are widely eaten and enjoyed among children and adults. This is as a result of their convenience nature in preparation and fast circulation. Snack foods are consumed primarily for pleasure and at social gatherings not for nutritive purposes nor used in a regular meal (Matz, 1993). Over the years and even in present time, potatoes and plantain have been the popular raw material used in the production of chips and crisps. They are usually made from thin slices of deep fried potatoes or plantain and are eaten as snack product all over the world (Smith, 1977 and Buton, 1989). Other types of chips are; tortilla chips, corn chips, bean chips, vegetable chips and pita chips. Among all these types of chips/crisps, cocoyam has been highly neglected despite its nutritive value and availability.

Cocoyam is at the phase of underutilization in Nigeria. It is basically eaten either boiled, roasted or in a porridge form by low income group which is the reason behind it been regarded as poor man's food or women's crop. Cocoyam is an herbaceous perennial plant belonging to the *Araceae* family and constitutes one of the six most important root and tuber crops world-wide (Ekanem and Osuji, 2006). It is popularly known as "ede" by the Ibos and "koko" by Yorubas. Cocoyam contains easily digestible starch as a result of the size of the starch granules (Lyonga and Nzietchueng, 2008). It contains substantial amounts of protein, vitamin C, thiamine, riboflavin, niacin and dietary fibre (Sefa-Dedeh and Sackey, 2002; Niba, 2003). Cocoyam is equally rich in vitamin B6 and magnesium which makes it suitable for the control of high blood pressure hence, stabilizes the heart. Owusu-Darko *et al.,* (2014) started that cocoyam is a rich source of carbohydrate, dietary fibre and low amount of fat, this makes it good raw material for health conscience individuals. The report that cocoyam contains the smallest starch grain-size relative to other roots and tubers enhance its suitability for several foods for potentially allergic infants, persons with gastro-intestinal disorders as well as diabetic patients (Onyenobi *et al.,* 2010). The smallest starch granules of cocoyam have been associated with increased

digestibility over other crops. Therefore, it is suitable for feeding invalids, production of confectioneries and baby foods (Eneh, 2013).

Irrespective of the nutritive advantages of cocoyam over other root and tuber crops (Nnabuk *et al.*, 2012) such as plantain and potatoes, it is still underutilized. In South Eastern parts of Nigeria, cocoyam is used in small quantities as a thicken agent in preparing a delicacy native soup by boiling and pounding to obtain a consistent paste. Cocoyam contains 7 – 9% protein while yam has less than 6% protein, cassava less than 3% and sweet potatoes are poor protein source (Nnabuk *et al.*, 2012). In the quest to improve the utilization of cocoyam and maximize its nutritional benefits, its starch has been modified and used in the production of chin-chin (Falola *et al.*, 2014), composite flour blends in cake (Alozie and Chinma, 2015), as well as in the production cake and chin-chin (Akusu *et al.*, 2016). Among all these efforts, little or no record exit in the production of chips/crisps using cocoyam. Initially, primarily known and consumed chips were plantain crisps until research brought about the version of potato chips/crisps. Cocoyam which has less utilization can be used in the production of chips/crisps all over the World. It can equally be converted into several specific food and feed products as well as for industrial purposes in order to popularize its cultivation.

Hence, the aim of this research is to produce crisps and chips from cocoyam using different pretreatments such as salt, sugar and a combination of salt and sugar solutions. Analyze the effects of these solutions on the proximate and sensory properties comparing with plantain chips to ascertain the best acceptable to the consumers without uttering the proximate properties of the product.

2. MATERIALS AND METHOD

2.1. Materials

The raw materials used for this study which include fresh cocoyam (*Colocasia esculenta*) of about 2kg and other ingredient such as iodized salt and sugar (Dangote Brands) as well as vegetable oil (King's Brand) were purchased from a local market (mile 3 market) in Port Harcourt, Rivers state, Nigeria and transferred to the food processing laboratory in the Department of Food Science and Technology, Rivers State University for immediate processing.

2.2. Method

2.2.1. Preparation of Cocoyam Chips

Fresh cocoyam tubers were peeled, washed properly with running tap water and divided into two equal portions. One portion was used for the production of cocoyam chips using the method outlined by Ukpabi *et al.*, (2013) with slight modifications while the second portion was used for the production of crisps. Careful precaution was taken to prevent cutting of hand during the slicing of crisps and chips using Meco Stainless Steel kitchen knife. Chips were slice to obtain uniform thickness and length of about 3mm and 5cm, respectively while crisps were slice into thin (about 1mm thickness) round shapes. They were further rewashed to remove surface starches. Solutions consisting of salt, sugar and a combination of salt and sugar were prepared. Prepared cocoyam slices were further divided into four equal portions each and labeled A – A3 and B – B3 samples. A1 – 3 and B1 – 3 were pretreated by soaking them in the prepared solutions respectively for 30min followed by the removal of the samples in colander. Samples A and B were left untreated while plantain chips that is already in existence in the market was used as the control and labeled AB sample. After which the cocoyam samples were deep fried separately using a deep pot containing 1.5 liters of vegetable oil at a temperature of 160^{o}C for 10min. They were removed from hot oil into a colander to drain excess oil, cooled at room temperature (28±2^{o}C) and stored in a polythene bag properly sealed for analyses.

2.3. Analyses

2.3.1. Proximate Composition

The proximate composition of the crisps and chips samples were analyzed for moisture, ash, protein, fibre and fat using the recommended AOAC (2012) method while Anthrone Reagent method reported by Osborne and Voogt (1978) was used to analyze the carbohydrate content of the samples.

2.3.2. Sensory Evaluation

Sensory evaluation was carried out using twenty trained panelists consisting of staff and students of Food Science and Technology Department, Rivers State University, Port Harcourt, Nigeria. Criteria for selection were that panelists were above 17 years of age and regular consumers of crisps and chips. They were neither sick nor allergic to deep fried snacks. 9 – point Hedonic Scale was used to evaluate the products with scores ranging from 1 to 9 which represent Dislike and Like extremely, respectively. The panelists were instructed to rinse their mouth with water after each sample taste so as to prevent carry over flavor and taste. The parameters evaluated were aroma, appearance, color, flavor, crispness, texture, mouthfeel and overall acceptability as described by Iwe (2010).

3. RESULTS AND DISCUSSION

3.1. Proximate Compositions

The proximate analysis showed that sample B (untreated chips) had significantly high (P<0.05) moisture content of 9.55% compare to other samples as presented in Table 1. This observation is a natural phenomenon which took place since chips are known to be moister than crisps after preparation. This result interline with the statement of Moreira *et al.,* (1997) that moisture content of products reduces with time of frying. Samples A1 and B1 pretreated with salt solutions were observed to contain lower moisture than those pretreated with sugar solutions. This implies that salt solution successfully impaired the moisture content of the products than sugar. Moisture value of the samples A, A1, A2, A3 and B1 compared significantly with that of sample AB (potato chips – control). Apart from the ash content of samples A1, A2 and B which compared significantly with sample AB, other samples had significantly (P<0.05) higher ash value. This is an indication that cocoyam contain more ash than potatoes which represent the total mineral content in estimate. Previous research have equally reported high ash content of products produced from 100% cocoyam flour than those from 100% wheat flour (Falola *et al.*, 2014; Alozie and Chinma, 2015). Sample AB (plantain chips) had low values of protein (4.39%) and fibre (3.16%) compare to crisps and chips produced with cocoyam. This is evident that cocoyam contains more protein and fibre than plantain while carbohydrate content of plantain chips was observed to be higher compare to those produced with cocoyam. The high protein value reported agreed with the literature that cocoyam contains substantial amounts of protein ranging between 7 to 9% (Nnabuk *et al.,* 2012). Akusu *et al.,* (2016) reported cake with highest value of fibre incorporated with 50% cocoyam flour. Pretreatment of cocoyam successfully decreased and increased the moisture and ash contents of the samples, respectively compared to the untreated samples as well as the control sample. It was equally observed that pretreatment of cocoyam crisps with either salt or sugar was an advantage over the untreated crisps. This conclusion is drawn based on the observed decreased fat values in the pretreated crisps samples while the untreated crisps had significantly highest fat content. This is an indication that pretreatment impaired oil absorption during frying.

Table 1: Proximate Composition of Cocoyam Crisps and Chips

Samples	Moisture %	Ash %	Protein %	Fibre %	Fat %	Carbohydrate %
AB	4.51±0.01^{c}	2.62±0.04^{c}	4.39±0.01^{e}	3.16±0.03^{e}	9.81±0.01^{b}	75.52±0.03^{a}
A	4.12±0.02^{c}	1.69±0.01^{cd}	6.15±0.14^{d}	4.35±0.03^{d}	11.76±0.25^{a}	71.98±0.39^{a}
A1	3.70±0.28^{c}	2.27±0.21^{c}	8.30±0.13^{c}	10.35±0.03^{a}	10.21±0.01^{b}	65.15±0.63^{b}
A2	3.82±0.20^{c}	2.19±0.09^{c}	9.17±0.88^{b}	2.75±0.03^{ef}	9.25±0.03^{bc}	72.78±1.25^{a}
A3	3.26±0.01^{c}	3.05±0.04^{b}	9.47±0.01^{b}	7.42±0.01^{b}	9.40±0.01^{bc}	67.39±0.12^{ab}
B	9.55±0.04^{a}	2.93±0.01^{bc}	10.21±0.01^{b}	5.51±0.01^{cd}	9.17±0.00^{bc}	62.64±0.06^{b}
B1	4.17±0.05^{c}	3.58±0.03^{b}	8.36±0.05^{c}	7.55±0.04^{b}	10.87±0.02^{ab}	65.48±0.11^{b}
B2	5.53±0.05^{b}	4.62±0.01^{a}	12.74±0.02^{a}	6.58±0.01^{c}	9.71±0.01^{b}	60.77±0.13^{b}
B3	5.12±0.02^{b}	3.02±0.02 ^{b}	12.39±0.01^{a}	2.21±0.01^{f}	10.84±0.06^{ab}	66.42±0.16^{ab}

a-f Means with the same superscript along the column does not differ significantly (P<0.05). ± Standard deviation of duplicate determination

Keys

AB = plantain chips (Control)
A = Plain crisps – Untreated
A1 = Salted crisps
A2 = Sugar crisps
A3 = Salted and sugar crisps
B = Plain chips
B1 = Salted chips
B2 = Sugar chips
B3 = Salted and sugar chips

3.2. Sensory Evaluation

The sensory evaluation carried out on the produced pretreated, untreated cocoyam crisps, chips and the plantain chips (control) showed that there was no significant difference (P<0.05) in the aroma scores between samples AB, A, A3 and B1 as shown in Table 2. The last three samples compared favorably with the control sample (plantain chips). Samples A1, A2 and B3 had the highest acceptability scores in terms of aroma. The appearance of the crisps samples including the pretreated and untreated significantly compared with the control (sample AB). Akinlua *et al.,* (2013) also reported a significant comparison between treated and untreated fried cocoyam slices. There was no significant difference in the color of all the samples. Significant low scores was observed in the flavor, crispness and texture of untreated chips (samples B) while other samples were highly acceptable base on the scores recorded. Samples A1, A2 and B3 had the highest overall acceptability scores. Although, sensory scores of all the samples is an indication that cocoyam crisps and

chips pretreated with salt, sugar and untreated were acceptable by the panelists comparing to the plantain chips. Hence, another version of crisps and chips can be produced using cocoyam to enhance its awareness and utilization by corporate and private bodies.

Table 2: Mean sensory scores of cocoyam chips and crisps

Samples	Aroma	Appearance	Color	Flavor	Crispness	Texture	Mouth feel	Overall acceptability
A	6.86^{ab}	6.81^{a}	6.71^{a}	5.48^{b}	5.91^{b}	6.09^{a}	6.38^{a}	6.85^{ab}
A0	6.95^{ab}	6.28^{a}	6.60^{a}	5.91^{ab}	6.39^{b}	5.91^{a}	6.19^{a}	6.95^{ab}
A1	7.20^{a}	6.71^{a}	6.97^{a}	6.55^{a}	7.28^{a}	6.30^{a}	6.39^{a}	7.20^{a}
A2	7.40^{a}	6.60^{a}	6.35^{a}	6.72^{a}	7.11^{a}	6.61^{a}	6.81^{a}	7.40^{a}
A3	6.95^{ab}	6.75^{a}	6.48^{a}	6.39^{a}	7.27^{a}	6.48^{a}	6.54^{a}	6.95^{ab}
B0	5.35^{b}	5.19^{b}	5.31^{a}	4.45^{c}	4.29^{c}	4.11^{c}	5.71^{ab}	5.35^{bc}
B1	6.55^{ab}	5.80^{b}	5.90^{a}	5.71^{b}	5.90^{b}	6.09^{a}	5.95^{ab}	6.53^{ab}
B2	5.95^{b}	5.87^{b}	5.62^{a}	5.54^{b}	5.20^{b}	5.52^{b}	5.71^{ab}	5.95^{b}
B3	7.30^{a}	6.48^{a}	5.93^{a}	6.19^{a}	5.93^{b}	6.46^{a}	6.79^{a}	7.30^{a}
LSD	0.45	0.55	0.50	0.50	0.43	0.55	0.41	0.45

^{a,b,c} Means with the same superscript along the column does not differ significantly (P<0.05). ± Standard deviation of duplicate determination

Key:

A = plantain chips (Control)
A0 = Plain crisps – Untreated
A1 = Salted crisps
A2 = Sugar crisps
A3 = Salted and sugar crisps
B0 = Plain chips
B1 = Salted chips
B2 = Sugar chips
B3 = Salted and sugar chips

4. CONCLUSION

The result showed that pretreatment of crisps and chips decreased the moisture content of the samples. This could lead to a longer shelf life of the pretreated samples than the untreated ones. The analyses revealed that both pretreated and untreated cocoyam crisps and chips contained more protein and fibre than plantain chips. The sensory acceptability of all the samples indicates that another acceptable version of crisps/chips can be produce using cocoyam. This will thus, increase the utilization of this raw material.

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