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THE EFFECT OF FLUORESCENT LIGHT AND PACKAGING MATERIALS ON THE SHELF LIFE OF PLANTAIN AND BANANA CHIPS DURING STORAGE

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ABSTRACT

The effect of light on the shelf life of two African plantain landraces and one cooking banana hybrid were investigated. Thin pulp slices of green unripe fruit were deep-fried in vegetable oil until crisp. The chips were packed in transparent and polythene bags and stored in a wooden cupboard specially designed for this study while some samples were kept outside the box. The cupboard is made up of two compartments, and the upper one is lighted with fluorescent tube, while the lower compartment is dark. The temperature in the lighted, unlighted compartment, and outside were 30-33°C, 24-27°C, and 24-26°C, respectively. Colour changes were determined every 24 hours by visual comparative of chips colour with a colour chart designed by the International Network for the Improvement of Banana and Plantain (INIBAP). It was observed that chips stored in the upper compartment of the cupboard where fluorescent tube was used developed objectionable flavour after a week of storage. Chips from Agbagba, Obino l'Ewai and BITA 3 packed in black polythene and stored inside the dark box versus lighted and outside had a shelf life of 147 days, 136 days and 45 days respectively. In contrast, chips from Agbagba and Obino l'Ewai packed in transparent bags and stored in lighted box maintained its yellow colour for 3 days each and 5 days for BITA 3. Generally, chips in black bags stored better than those in transparent bags irrespective of storage conditions. Similarly, chips packed in transparent polythene and stored in unlighted box had a better storage life compared to samples packed in transparent bag and exposed to light.

Key words: fluorescent light, packaging materials, shelf life, cooking banana hybrid, yellow colour.

INTRODUCTION

Plantain and banana (*Musa* spp.) are important staple foods that are critical to the nutrition and economic status of millions of people throughout the developing world and are grown in about 120 countries (Olorunda, 2000). Post harvest loss is a major problem limiting the availability of plantain and banana fruits in many parts of sub-Saharan Africa, which is primarily due to unavailability of adequate storage conditions that can guarantee longer shelf life, and lack of processing technologies. FAO (1987) estimated plantain losses at 35% in developing countries, but processing could offer a means of adding value to the fruit while extending shelf life, facilitating transportation and exploiting a greater number of marketing options. Plantain and banana chips are one of such processing options, which can be accomplished by deep-frying green unripe or partially ripe pulp slices, packaged and preserved for a longer time, when compared to fresh fruit. Adeniji *et al.* (1997) confirmed this in their report on enhancing utilization of cooking banana in rural areas of south-eastern Nigeria, while Stover and Simmonds (1987) listed banana and plantain chips among products that are commonly utilised in international commerce. Plantain and banana are highly suitable for chips processing probably as a result of their high starch content at harvest. The total energy content of unripe or ripe plantain fruit is about 128kcal/100g edible portion as stated by Platt (1985), in which carbohydrate (starches and sugars) contribute about 95%, while the rest comes from fat and protein. Most often, bananas are either eaten raw as dessert bananas or prepared by cooking, fermenting, or drying, according to the cultivar (Wainwright and Burdon, 1991). Plantain on the other hand is traditionally grown for cooking as part of a staple diet or for processing into more durable products such as flour that can be stored for later use (Dadzie, 1995; Wainwright and Burdon, 1991).

Experience has shown that the quality of plantain chips is greatly affected when exposed to light generally, either fluorescent, incandescent or sunlight. Light is a form of electromagnetic radiation, which travels in waves. The wavelength determines the colour and the energy level (Chapman and Carter, 1976). There are empirical facts that different colours reflect different wavelengths of light with consequence effects on physiological behaviour of plant and their products (such as plantain chips). The typical golden

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yellow colour of plantain chips fades away gradually and turns to pale yellow and white colour (Ogazi, 1985) during storage. The use of cellophane is recommended for packaging to increase the shelf life of plantain chips because cellophane is non-permeable to water, water vapour and air, while polyethylene is permeable to air (Ogazi, 1996).

Ferris (1998) reported that processing has a great potential in the marketing chain, but considerable improvements should be made in the processing technologies to enable local enterprises develop and expand before they can create more income and generate jobs. As plantain and banana command such a stronghold in the industrialised world, it is appropriate to conduct more research to identify new markets for processed products and find technologies to supply high-quality products at acceptable prices. Processing of plantain chips in Nigeria has received some level of improvement with the use of electric fryer and adequate packaging to meet both domestic and export markets. Locally made chips are presently available in supermarkets and chips are also being served as snacks in some of the airlines operating in Nigeria. In this study, therefore, the effects of fluorescent light and packaging materials on the shelf life of plantain and banana chips were investigated to enhance its marketing potentials.

MATERIALS AND METHODS

Bunches of plantain and cooking banana hybrid were obtained from the experimental plot of the International Institute of Tropical Agriculture (IITA) High Rainfall Station, Onne, Port Harcourt. Bunches were harvested green at maturity and de-handed before de-fingering of individual fruits into a bucket containing water. The fruits were washed to remove dirt and latex exuding from the fruit, and peeling was performed carefully and neatly with the aid of a stainless kitchen knife. Salt was sprinkled on the peeled fruits in a bowl and mixed thoroughly to taste. The fruit was then sliced disc-wise with the aid of a plantain slicer into a pre-heated cooking oil at 190°C. Direct slicing of fruit into the oil was employed to prevent sticking of pulp slices due to high level of starch present in plantain and banana fruit at harvest. The chips were removed and drained to cool at room temperature of about 24-26°C when crisp. The oil contents of the chips were kept low by proper draining using sieves to prevent colour and flavour deterioration. Wholesome chips were selected and packed in both transparent and black polyethylene bags and sealed with electric sealer. A wooden cupboard of 100.5m length, 66m breadth, and 35m width consisting of two compartments was specially designed and constructed for this work. A fluorescent tube of 18W/33 was fitted in the inner part of the upper compartment of the cupboard and also lined with aluminium foil to increase light intensity on the samples. Light was excluded from the lower compartment and the packaged chips were stored both in the lighted and dark compartments, and also outside the cupboard (control). The temperature ranges in the lighted and unlighted compartment, and outside were 30-33°C, 24-27°C, and 24-26°C, respectively. Colour changes were determined every 24 hours based on colour chart designed by the International Network for the Improvement of Banana and Plantain (INIBAP).

RESULTS AND DISCUSSION

Chips stored in the upper compartment of the cupboard where fluorescent tube was installed developed objectionable flavour and oil stain was observed after one week using an impromptu sensory panellists. Chips in light box also sticks to each other during storage and this affects the sensory qualities and could also affect the market. Samples in the dark compartment and those stored outside the cupboard did not exhibit these characteristics due to the absence of light and heat energy. Chips stored outside the box were also exposed to fluorescent light but at a distance. The development of off flavours and colour defects in chips could be as a result of rancidity. Rancidity is caused by the hydrolysis of the glycerides and release of fatty acids such as butyric and caproic, which have strong and repulsive odour (Ihekoronye and Ngoddy, 1985). Results presented in Table 1 show that Agbagba, Obino l'Ewai and BITA 3 packed in polythene bag and stored in unlighted compartment maintained their normal colour for 147 days, 136 days and 45 days respectively. Chips from BITA 3 turned white faster than those from Obino l'Ewai and Agbagba probably because fresh chips from BITA 3 had light yellow colour compared to yellow colour of both Obino l'Ewai and Agbagba chips. BITA 3 is a cooking banana hybrid and it is characterised by light yellow coloured pulp compared to yellow colour of both Obino l'Ewai and Agbagba pulp. Colour differential was therefore noticed in chips produced from these cultivars, which also have effect on their storage potentials. Chips made from Agbagba and Obino l'Ewai packed in transparent bags and stored in lighted compartment had a shelf life of 3 days each, and 5 days for BITA 3. Generally, samples stored in black bags kept better than those stored

in transparent bags irrespective of storage conditions. In addition, chips facing light changed faster, which further confirms that light promotes colour degradation in plantain chips and other products (Ogazi, 1985). The shelf life of plantain chips can be enhanced by using opaque polyethylene bags for packaging, and store either in a dark or open environment. Chips may also be packed using transparent bags and stored in dark environment. However, packaging of products using opaque bags makes it impossible for visual appreciation of products by consumers. Plantain chips may be packed in opaque bag with relevant information about the product. Deterioration due to rancidity can be controlled by removal of oxygen or replacing the air in the package with an inert gas such as nitrogen (Ogazi, 1996), and the incorporation of suitable antioxidant at permitted levels could also minimise this problem. The initial and finishing temperatures for plantain chips should be between 177-190^{o}C and 160-174^{o}C, respectively (Thompson, 1995). The temperature and frying time affect the oil content, appearance, texture and flavour of plantain chips. This must be determined experimentally before commencement of commercial processing. In this present study, the initial and finishing temperatures was 190 ^{o}C and frying was done for a few minutes, with the end product having about 1.5-2% moisture content.

TABLE 1: COLOUR CHANGES IN PLANTAIN AND BANANA CHIPS DURING STORAGE

Cultivar	packing & storage	days to colour changes	
BITA 3	TO	light-yellow (35)	white (45)
	BO	light-yellow (86)	white (98)
	TD	light-yellow (32)	white (35)
	BD	light-yellow (45)	white (51)
	TL	light-yellow (5)	white (15)
	BL	light-yellow (15)	white (86)
Obino l'Ewai	TO	yellow (31)	white (147)
	BO	yellow (98)	yellow-white spots (147)
	TD	yellow (136)	light-yellow (147)
	BD	yellow (136)	light-yellow (147)
	TL	yellow (3)	white (31)
	BL	yellow (38)	white (107)
Agbagba	TO	yellow (31)	white (126)
	BO	yellow (126)	yellow-white spots (147)
	TD	yellow (38)	yellow-white spots (147)
	BD	yellow (147)	NA
	TL	yellow (3)	white (27)
	BL	yellow (58)	white (98)

TO=chips packed in transparent polythene and stored outside the box; BO=chips packed in black polythene and stored outside the box; TD=chips packed in transparent polythene and stored in unlighted box compartment; BD=chips packed in black polythene and stored in unlighted box compartment; TL=chips packed in transparent bag and stored in lighted box compartment; BL=chips packed in black bag and stored in lighted box compartment; NA=not available.

CONCLUSION

The colour and textural characteristics (crispness) of plantain and banana chips are major determinants of product quality, and must be preserved after processing. Both plantain and banana are highly suitable for chips processing, which may constitute an important product for domestic and export markets. This study has relevant data to circumvent some of the major constraints confronting plantain and banana chips manufacturers and therefore boost its market potentials. Following the distribution and acceptance of new plantain and banana cultivars in Nigeria, processing should be enhanced to accommodate surpluses. It is anticipated that chips processing could add value to plantain and banana and consequently enhance their industrial potential.

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