African Journal of Biotechnology Vol. 5 (19), pp. 1803-1807, 2 October 2006
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2006 Academic Journals

Full Length Research Paper

Nutrient composition and storage studies on roselle extract enriched deep-fat-fried snack food

Daramola, B.* and Asunni, O. A.

Department of Food Science and Technology, Federal Polytechnic, P.M.B. 5351, Ado Ekiti, Ekiti State, Nigeria.

Accepted 12 September, 2006

Roselle extract fortified deep-fat-fried snack food (R_eSF) developed was evaluated for nutritional and organoleptic enrichment. Effect of the extract and package films on oxidative changes in R_eSF as affected by display conditions were also examined. R_eSF is rich in dietary Fe (1965 µg/g sample) with variable organoleptic profile. The Roselle extract exerted inhibitory activities on peroxidation. Display of R_eSF under day or dark as opposed to display under direct sunlight exerted protection (PF = 0.90) of product from light induced deterioration. Application of translucent film for packaging of R_eSF conferred protection on the snack food against light induced peroxidation.

Key words: Roselle extract, fortification, deep-fat-fried snack, display condition, packaging.

INTRODUCTION

The global campaign for nutritional enrichment of food by blending with richer stuff and preservation of food by exploiting nature's protective measures, expressed in terms of bioactive components from plant products as against the use of synthetic compounds continues to be a veritable tool for public health management. Roselle (*Hibiscus sabdariffa*) calyx is used for production of fruit drink in the tropics. Demand is on the increase because of nutraceutics endowment of the natural food drink (Salmah et al., 2003). Roselle calyx has been reported to be rich in anthocyanin and dietary iron (Seguchi and Hayashi, 1998). Wang et al. (1997) has confirmed the antioxidative attributes of anthocyanins and their aglycons against peroxyl radicals. Pizza is one of the deep-fat-fried products commonly consumed among all and sundry especially nursery and primary school pupils as refreshment meal in Nigeria. There has being an increase in the volume of sales of cookies in our locality. This has been attributed to large purchase by school pupils as revealed by our informal survey on snacks marketing.

In view of the present enormous market and anticipation for future expansion for cookies, we embanked on development of a self-inherent resistance to oxidation iron-fortified snack food using active components of roselle calyx. Effect of package materials on quality attributes of product in relation to display conditions was also examined. To our knowledge this study has not appeared in literature.

*Corresponding authors E-mail daramola _bode@yahoo.co.uk.

MATERIALS AND METHODS

Materials

Roselle calyx and vegetable oil were obtained from King's market, Ado Ekiti, Ekiti State, Nigeria. Ingredients (commercial grade) for pizza (deep–fat–fried snack) are as shown in Table 1. Transparent and translucent (medium density polyethylene) films were used for packaging.

Extraction of bioactive components of roselle calyx

Roselle calyx (31.00 g) was boiled in water (200 ml) for 20 min, filtered and concentrated before application.

Preparation of pizza

Pizza (deep-fat-fried snack) was produced according to flow diagram in Figure 1. The proportion of ingredients used is shown in Table 1. Fortified deep-fat-fried snack was prepared by adding the

Table 1. Pizza ingredients and proportion.

Ingredient	Quantity
Flour	550g
Baking powder	5g
Margarine / fat	57.3g
Sugar (granulated)	40g
Salt	2.9g
Water	280ml
Roselle extract added at 3 levels	0:280//25:255//6:274

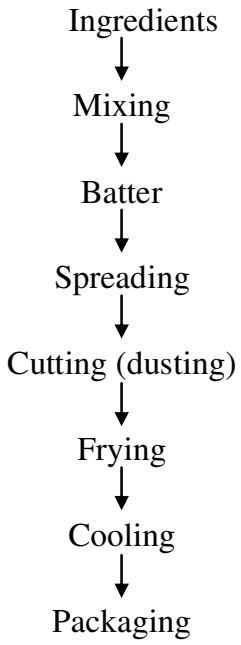

Figure 1. Flow chart of production of deep-fat-fried snack food.

concentrated roselle extract at two levels; 6 and 25 ml of extracts in beakers were made up to 200 ml with water to formed snack batter ($ReSF_1$ and $ReSF_2$, respectively) and unfortified deep-fat-fried snack (control sample, SF) was prepared (third level) as above but without addition of roselle extract.

Determination of nutrient composition

Proximate composition of pizza samples was determined according to the method of AOAC (1990) for moisture, total ash, crude fat, crude protein and crude fibre respectively. Carbohydrate was obtained by difference. Minerals were evaluated using atomic absorption spectrophotometer (AAS) in accordance with the method of A.O.A.C (1990) Ref No. 968.08.

Inhibition of peroxidation in pizza by bioactive components in roselle

Assessment of inhibition of peroxidation in pizza caused by bioactive components in Roselle was evaluated. Fortified and unfortified samples were studied under verisimilitude of different commercial display conditions (essentially direct sunlight, day) in relation to packaging in different polyethylene films. Oxidative stability was monitored by measuring peroxide values at regular interval during the storage period. Decrease in the rate of formation of peroxide was used as a measurement of inhibition of peroxidation effectiveness of fortified samples in comparison to unfortified sample (Chang et al., 1997).

Sensory qualities of roselle fortified and unfortified snack food

Sensory qualities of roselle fortified and unfortified deep-fat-fried snack food were determined subjectively following the procedure of Demooy and Demooy (1990).

RESULTS AND DISCUSSION

Nutrient composition of roselle fortified deep-fat-fried snack ($ReSF_1$, $ReSF_2$) produced by the two extract fortification regime and unfortified (SF) deep fat-fried snack food samples is presented in Table 2. Samples $ReSF_1$ and $ReSF_2$ contain higher amounts of protein (10.34%, 10.55%), ash (1.15%, 1.16%) and fat (27.35%, 29.85%) in comparison to the low amounts of protein 10.10%, ash 1.14% and fat 26.35% for unfortified sample. Emphasis was placed on dietary iron in this study because roselle calyx (Seguchi and Hayaschi, 1998) has been reported to be a good source of the nutritional element. Sample $ReSF_2$ contain 1965 µg of dietary Fe per g of sample. This implies that consumption of two packs (40 g) of the snack will furnish consumer with 40 x 2 x 1965 µg of dietary Fe. This will contribute to meeting the daily requirement of 18 mg/day (for pupil-age-group) of dietary Fe (National Research Council, 1980). Dietary Fe is an important factor in component of haemoglobin of the blood, an integral moiety for transportation of oxygen in the blood. The Greater need for dietary iron is associated with infancy and adolescence.

Sensory characteristics of deep-fat-snacks at fry-point

Sensory characteristics of Pizza at fry-point are presented in Table 3. Addition of roselle extract to pizza conferred various organoleptic characteristics. Effect of roselle extracts is proportional to the level of extract added to pizza. There was an improvement of tenderness and oil-moistness of product fortified with roselle extract in comparison with product not fortified with roselle extract. Leaven attributes of extract fortified snack food appeared to be enhanced. The improvement is believed to be due to the acidic nature of bioactive components in roselle extract. Seguchi et al. (1997) reported that gaseous acetic acid improves leavening attributes of baked product. The improvement in leavening of the snack lead to high oil absorption, this assertion was corroborated by high fat content of Roselle extract

Table 2. Nutrient Composition of Roselle fortified and unfortified deep-fat-fried snack food.

Nutrient composition	SF	$ReSF_1$	$ReSF_2$
Protein (%)	10.10 ± 0.02[a]	10.34 ± 0.00	10.55 ± 0.01
Ash (%)	1.14 ± 0.00	1.15 ± 0.00	1.16 ± 0.00
Moisture (%)	2.46 ± 0.00	1.87 ± 0.01	1.67 ± 0.00
Fat (oil) (%)	26.35 ± 0.35	27.35 ± 0.27	29.85 ± 0.82
Crude fibre (%)	0.03 ± 0.00	0.02 ± 0.00	0.01 ± 0.00
Carbohydrate[b] (%)	59.48 ± 0.00	59.37 ± 0.00	57.23 ± 0.00
Fe (micro g/g)	1035 ± 24.00	1050 ± 15.4	1965 ± 31.00
Ca (micro g/g)	10.00 ± 0.08	16.0 ± 0.3	25.5 ± 0.80

[a]Values are mean ± SD
[b]Obtained by difference

Table 3. Sensory characteristics of pizza at fry-point.

Quality attribute	SF	$ReSF_1$	$ReSF_2$
Tenderness	Hard	Tender	Very tender
Moistness (oil)	Slightly moist	Moist	Very moist
Appearance	Smooth	Moderately rough	Rough with pores
Taste	Good	Good	Very good
Flavour	Pleasant	Pleasant	Pleasant
Colour	Golden yellow	Yellow	Olive brown

fortified product in comparison to unfortified product (Table 2). Moreover, sample SF appeared smoother than the other samples, $ReSF_1$ and $ReSF_2$. Smoothness decreases with increase in level of roselle extract added to pizza batter. The rough appearance of roselle fortified sample is as a result of pores caused by the leaven promoter which was believed to be due to the acidic components in the roselle. Both fortified and unfortified snack foods were pleasant at taste.

Inhibition of peroxidation by roselle extract

Rate of peroxidation in unfortified (SF) snack sample was studied in relation to roselle fortified samples ($ReSF_1$ and $ReSF_2$). Peroxide values of the samples were determined when the samples were fresh and periodically at 7 days interval for 28 days (Figure 2). Inhibition of peroxidation was observed in $ReSF_1$ and $ReSF_2$ when compared with high peroxidation in SF. Antiperoxidation of roselle active components increased with increasing concentration of roselle extract added. Antioxidant activities of anthocyanin, the lead component of roselle calyx, are well established in literature (Takeoka et al., 1997).

Although, the biochemical components of the roselle calyx contain the pro-oxidants Fe as well as an highly oxidative component anthocyanin, observation of inhibition of peroxidation in the snack could be due to some compounds which are produced concurrently with products of peroxidation, which exhibit antioxidant properties (Alaiz et al., 1996). These could be oxidized lipid

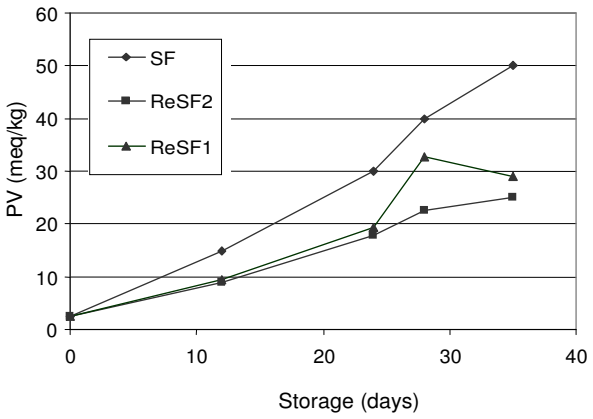

Figure 2. Peroxidation of unfortified and roselle fortified snack food in simulated day display.

/amino acid reaction products, formed at the final step in lipid peroxidation in the presence of protein (Hidalgo et al., 1998).

Effect of storage conditions on rate of peroxidation in deep-fat-fried snack food

Effect of storage/display of pizza (unfortified and roselle fortified) under different conditions namely, day, dark and direct sunlight on rate of peroxidation was studied. This was necessitated by the fact that light is one of the food

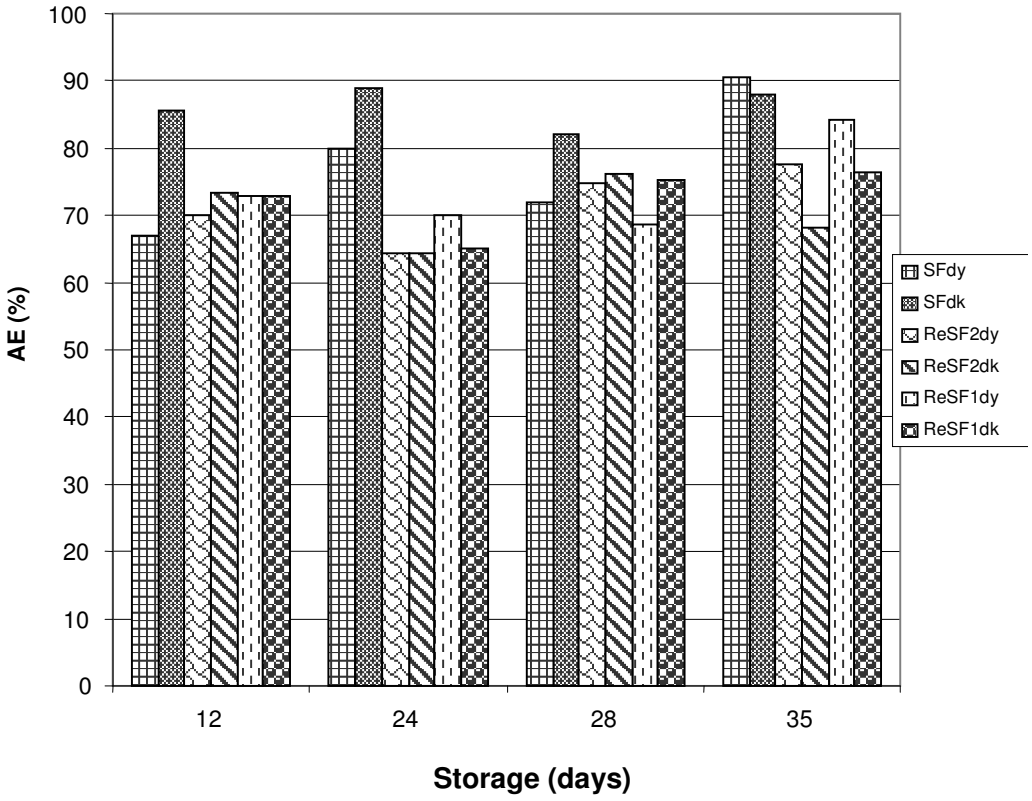

Figure 3. Effectiveness of display conditions on degree of peroxidation.

deteriorating agents. It is responsible for oxidation in many outdoor display-packaged foods, resulting in fading of colours, loss of nutrients and formation of noxious products and oxidation of fatty foods (Surguy and Karel, 1980; Chamberlin and Chamberlin, 1980). The deleterious effects of light rays on foods such as pizza that has high content of oil is directly proportional to the wavelength and have been reported to be higher in short rays (290–340 nm) than in the longwave (340–400 nm) in the visible range of sun-light. Effectiveness of inhibition of peroxidation in the products (SFdy, SFdk, $ReSF_2$dy, $ReSF_2$dk, $ReSF_1$dy and $ReSF_1$dk) stored in day (dy) and dark (dk) conditions in relation to the same product stored under direct sunlight (su) as practiced in most of the outdoor food display in the tropics was evaluated (Figure 3). Findings showed that product stored/displayed under day or dark exert high inhibition effectiveness in relation to storage/display under direct sunlight. Inhibition effectiveness appeared to be pronounced mostly in sample SF. This is not unexpected because this is the product that was most prone to oxidation (Figure 2) while the extent of inhibition of oxidation in samples $ReSF_1$ and $ReSF_2$ were similar. The large inhibition effectiveness of dark and day storage conditions was responsible for keeping of organoleptic attributes of the pizza in contrast to development of objectionable odour in the products stored under direct sunlight.

Effect of packaging materials on rate of peroxidation in deep-fat-fried snack food

Each of the products (SF, $ReSF_1$, $ReSF_2$) was packaged in medium density transparent (TP) and translucent polyethylene (TL) materials and placed under direct sunlight for studies. Progress of peroxidation was evaluated by determination of peroxide value for 28 days at regular (7 days) interval (Figure 4). Generally, peroxide values of products packaged in transparent film were higher than their corresponding counterparts stored in translucent film. In addition, degree of oxidation in the products was relatively in the order: $SFTP_{su}$//$SFTL_{su}$ > $ReSF1TP_{su}$//$ReSF1TLI_{su}$ > $ReSF2TP_{su}$//$ReSF2TL_{su}$. This order implied that the application of additives (roselle extract) and translucent package film cooperatively conferred protection from peroxidation on the products.

The results obtained in this study agreed with established fact that transparent packagings do reflect part of the incident light energy at low wavelengths and absorbs the rest which can trigger off auto-oxidation. Consequently, oxygen-sensitive foods, high in poly unsaturated fatty acid, therefore can be protected by reducing the amount of absorbed rays through the use of light proof packages such as translucent films. Translucent film materials with poor gas barrier are light proof and therefore their application in packaging of deep- fat-fried product signifi-

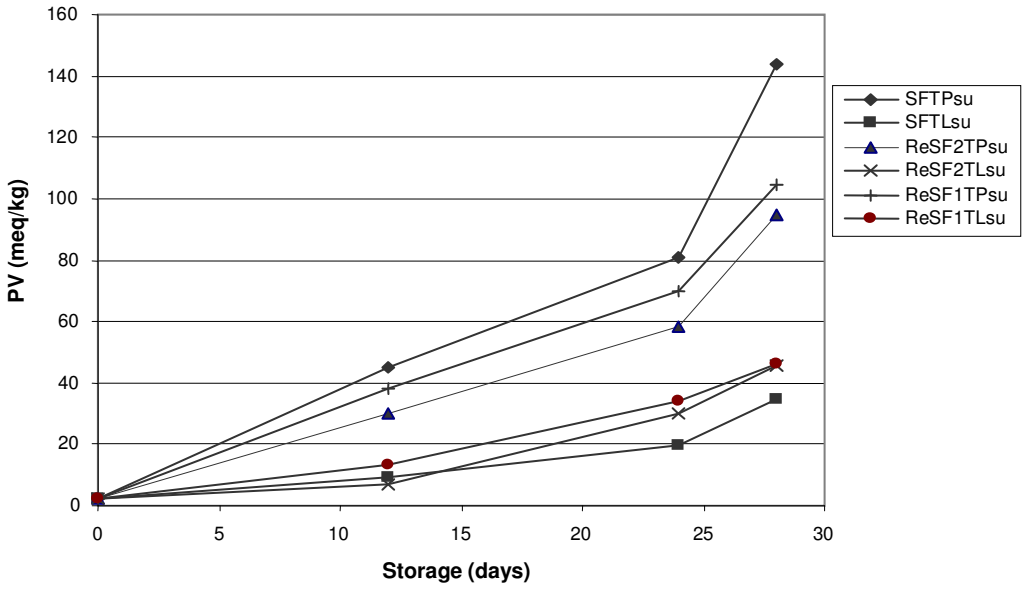

Figure 4. Peroxidation of packaged unfortified and roselle-fortified snack food displayed under direct sunlight.

cantly reduce rate of peroxidation. Thus extend their storability in the display condition prevalent in the tropics.

CONCLUSION

Addition of Roselle extract to formulation of deep-fat-fried snack food increases the nutritional status with concomitant delay of peroxidation. Translucent packaging retard degradation of the quality attributes of the products when displayed under direct sunlight.

REFERENCES

AOAC (1990). "Official Method of Analysis" 13th Edition Association of Official Analytical Chemist, Washington. DC.

Chamberlin GJ, Chamberlin DG (1980). Colour: Its Measurement, Computation and Application Heyden and Son ltd. Spectrum House, Hillview Gardens, London pp 112 – 116.

Chang S S, Ostric-Matijasevic B, Asieh O A, Huang C L (1997). Natural antioxidant from rosemary and sage. J. Fd. Sci 42: 1102-1106.

Demooy B E, Demooy C J (1990). Evaluation of cooking time and quality of seven diverse cowpea (*Vigna unguiculata*) varieties. Int. J. Food Sci and Tech 25: 202 – 212.

Hidalgo J F, Zamora R, Alaiz M, Ahmaid I (1998). Effect of oxidized lipid / amino acid reaction products on the antioxidative activity of common antioxidants. J. Agric Food Chem 46: 3768 – 3771.

Wang H, Cao G, Prior R L (1997). Oxygen radical absorbing capacity of anthocyanins. J. Agric. Food Chem. 45: 304-309.

National Research Council (1980). Food and Nutrition Board, Recommended dietary allowances 9th edition National Academy of Sciences.

Salmah Yusuf, Peng-Kong, Hasanah Mohd Ghazail, Yaakot bin Cheman (2003) Optimization of hot water extraction of roselle juice using response surface methodology: a comparative study with other extraction methods. J. Sci of Food and Agric. 83: 1273 - 1278

Seguchi M, Hayashi M, Matsumofo H (1997). Effect of gaseous acetic acid on dough theological and bread making properties. Cereal Chem. 74: (2) 129 – 134.

Seguchi M, Hayashi M (1998). Iron-enriched bread with karkade (*Hibiscus sabdariffa*) and wheat flour. Cereal Chem 75 (5):686 – 689.

Surguy I, Karel M (1980). Modelling of quality deterioration in food process and storage Food Technrol 60: 61 – 62.

Takeoka GR, Dao LT, Full GH, Wong RY, Harden LA, Edwards RH, Berrious JJ (1997). Characterization of Black been (*Phaseolus vulgaris L*) anthocyanin J. Agric. Food Chem. 45:3395–3400.