



NIGERIAN INSTITUTE OF FOOD SCIENCE AND TECHNOLOGY

NIFST Western Chapter

(ReFoSTS 2019)

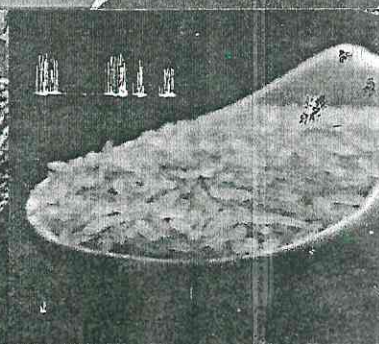
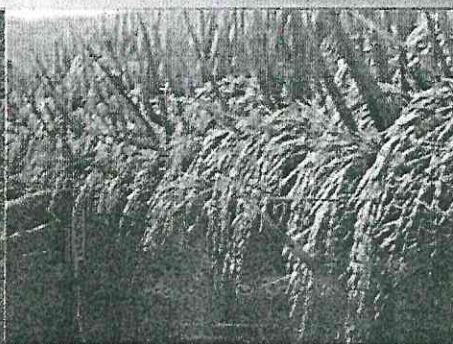
PROCEEDINGS OF



REGIONAL FOOD SCIENCE AND TECHNOLOGY SUMMIT

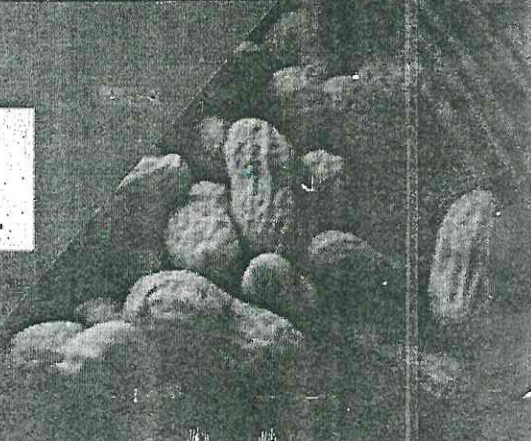
Date:
10th & 11th
June, 2019

Venue:
Nigerian Stored Products
Research Institute
(NSPRI), Ilorin



Editors:

AKINWANDE, B. A. | KARIM, O. R.
OLATUNDE, S. J. | OYEYINKA, S. A.
RAJI, A. | ABIOYE, V. F. | BOLARINWA, I. F.



EFFECT OF EXTRUSION ON THE COLOUR, BETALAIN AND ANTIOXIDANT PROPERTIES OF YELLOW MAIZE-BEETROOT SNACK

Abiodun, O.A.¹, Ojo, A.² and Ore, H.O.¹

¹ Department of Home Economics and Food Science, University of Ilorin, Kwara State

² Department of Food Science and Technology, Osun State Polytechnic, Iree, Nigeria

*Corresponding Author: Funmiabiodun2003@yahoo.com

Abstract

The effect of extrusion on the colour, betalain and antioxidant (radical scavenging) properties of yellow maize-beetroot snack was determined. Beetroot were washed, peeled, sliced and dried in dehydrator at 45°C for 18 h. The dried slices were milled and packaged in air tight container. Beet root flour was added to corn flour at different proportions (5, 10, and 15 %). The flours were extruded using fabricated extruder and colour, betalain and DPPH radical scavenging activities were determined. Beetroot was added to yellow maize using varying proportion of 5:100, 10:90, 15:85 and 20:80. There were significant differences in L* values (73.51 to 53.61) of the extruded snacks. A range of 10.09 to 0.26 was obtained in the betacyanin content, while the radical scavenging activities with the highest obtained in (39.35) 15% and the least (10.1) was obtained in 100% flour.

Introduction

Beetroot (*Vulgaris ruba* L.) is a crop belonging to the family *chenopodiaceae* having bright crimson color. It's known by several names such as beet, spinach beet, white beet, chukander (India), garden beets etc. Ravichandran *et al.* (2013) reported that red beetroot has high concentration of betalains which are used as food colorants and food additives as a result of their health promoting properties. Betalains are class of red and yellow indole-derived pigments found in the plant of cryophyllase, where they replace anthocyanin pigments. Betalains exhibit broad pH stability which are suited for low-acid foods where coloring with anthocyanin is usually not possible (Stintzing and Carle, 2004). Beetroot can be eaten raw, boiled, steamed and roasted. However; it is a rich source of minerals, antioxidants, vitamins, fiber and natural dyes (Ingle *et al.*, 2013). According to Tesoriere *et al.* (2005) and Kanner *et al.* (2004), betalains is natural antioxidants that may provide protection against oxidative stress-related disorders.

Processing of red beetroot before consumption was observed to influence the stability of betalains which affects the acceptability and health properties (Ravichandran *et al.*, 2013). Red beetroot had been incorporated into food products such as biscuits, tomato paste and cookies (Ibraheem *et al.*, 2015; Sahni and Shere 2016; Ingle *et al.*, 2017). This paper investigated the effect of extrusion on colour, betalain and antioxidant properties of yellow maize-beetroot snack.

Materials and Methods

Fresh deep red beetroot was purchased from Bukuru market, Jos, Plateau State while yellow maize (P4226 variety) was obtained from Root and Tuber Expansion Programme, Ajase-Ipo, Kwara state. The beetroots were washed, peeled, thinly sliced and dried in dehydrator for 18 h. Dried beetroot chips were kept in air tight plastic container. Maize was dry cleaned and milled using attrition milling machine into flour, sieved and packed before used. Beetroot proportions (5, 10 and 15%) were added to corn flour. The formulated flours were extruded using fabricated extruder. Methods of Hsu *et al.* (2003) was used for colour analysis using

colorimeter (WN 18 FRU model) and method of Ravichandran *et al.* (2013) were used for DPPH scavenging activity and betalain determination.

Results and Discussion

Results obtained for colour of the blends of beetroot and maize flour are shown in Table 1. The flour blends showed variation in the colour parameters (L^* : 73.51 to 65.47; a^* : 5.22 to 5.31; and b^* : 23.93 to 21.92). Sample E_0 had the highest L^* value while the least value was obtained in E_3 . The extruded snacks had a range of L^* values between 53.61 and 55.43. Snacks made from flour blend E_0 similarly showed the highest L^* value, while the E_3 had the least. This indicates extrusion process had a great impact on the colour of the products. There was no significant difference ($p < 0.05$) in the values of a^* (redness) of the flour samples and samples with 10 and 15 % beetroot flour. Yellowness (b^*) values were more pronounced in the corn flour and sample with 5% beetroot flour with values of 28.93 and 26.62, respectively. The b^* values decreased in the flour blends with addition of beetroot flour while the values increased in the extruded products. Extrusion cooking reduced the brightness and yellowness of the products. This corroborates the findings of Sacchetti *et al.* (2004). However, Sacchetti *et al.* (2004), explained that the colour changes in rice based snacks were as a result of the temperature of the extruder. Extrusion process decreases the intensity of the colour as a result of degradation of the pigment in the products due to high temperature.

Table 1: Colour of the blends of beetroot and maize powder and snacks

Sample		L^*	a^*	b^*
Flour	E_0	73.51±0.92a	5.22±0.45a	28.93±1.24a
	E_1	68.90±2.01b	5.09±0.37a	26.62±1.66b
	E_2	66.59±1.42c	5.37±0.37a	23.13±1.07c
	E_3	65.47±1.59	5.39±0.27a	21.92±0.78d
Extruded product	E_0	55.43±2.56e	2.52±0.15b	13.14±0.31g
	E_1	54.70±3.29f	2.93±0.70b	13.35±2.24g
	E_2	53.28±0.64h	4.68±0.18a	15.54±0.35f
	E_3	53.61±1.04h	5.15±0.35a	16.29±0.55e

Values are means ± standard deviation column values with different superscript are significantly ($p \leq 0.05$) different.

E_0 : 100% beetroot powder, E_1 : 95% yellow maize, 5% beetroot powder, E_2 : 90% yellow maize powder, 10% beetroot powder, E_3 : 85% yellow maize powder, 15% beetroot powder, E_4 : 80% yellow maize powder, 20% beetroot powder

There was variation in the Betacyanin (10.09- 65.47 mg/L), betaxanthin (4.90-33.00 mg/L) and betalain (15.1-98.48 mg/L) contents in the flour samples. Flour blend E_0 had the highest value while the least was observed in the extruded product E_1 , although E_1 had no beetroot blend (Table 2). The values were significantly different ($p < 0.05$) from other flours and extruded products. The betacyanin, betaxanthin and betalain values increased in the flour with increase in beetroot contents. There were significant differences ($p < 0.05$) in the values of the flours and the extruded products. There was reduction in the values obtained for the extruded products and this may be due to destruction of these compounds as a result of high temperature produced during processing. Betalain values observed in the extruded products were lower than the values reported for biscuits (Srivastava and Singh, 2016). Ibraheem *et al.* (2016) suggested that pH, temperature, oxygen, water activity, and light may affect the stability of betalain pigments. The temperature of the product recorded during extrusion

ranged from 85 to 90°C which was above 50°C. Thermal degradation of betalains was reported to take place at temperature above 50°C (Ibraheem *et al.*, 2016). The higher temperature for the extrusion process in this study may explain the reduction in the betalain contents of the extruded products.

Table 2: Betalain content of the blends of beetroot and maize flour and products

Sample		Betacyanin (mg/L)	Betaxanthin (mg/L)	Betalain (mg/L)
Flour	E ₀	65.47 ^a ±0.14	33.00 ^a ±0.28	98.48 ^a ±0.15
	E ₁	2.49 ^d ±0.69	1.60 ^d ±0.30	4.55 ^d ±0.05
	E ₂	5.24 ^c ±0.14	2.63 ^c ±0.14	7.87 ^c ±0.29
	E ₃	10.09 ^b ±0.00	4.90 ^b ±0.28	15.1 ^b ±0.01
Extruded product	E ₁	0.26 ^e ±0.00	0.14 ^f ±0.01	0.40 ^f ±0.01
	E ₂	0.67 ^f ±0.00	0.40 ^e ±0.01	1.07 ^e ±0.01
	E ₃	0.98 ^e ±0.00	0.41 ^e ±0.01	1.39 ^e ±0.01

Values are means ± standard deviation column values with different superscript are significantly (p≤0.05) different.

E₀: 100% beetroot powder, E₁: 95% yellow maize, 5% beetroot powder, E₂: 90% yellow maize powder, 10% beetroot powder, E₃: 85% yellow maize powder, 15% beetroot powder, E₅: 80% yellow maize powder, 20% beetroot powder

DPPH scavenging activities of substituted corn flours with extruded products ranged from 10.11 to 39.35% (Figure 1). Corn flour had lower antioxidant property (17.41%) than other flours. DPPH scavenging activities increased with increase in beetroot substitution in corn flour. Antioxidant values decreased in the extruded products. The percentage reductions were 41.92, 43.41, 34.52 and 36.31 % for control corn, 5, 10 and 15%, respectively. Although there were reductions in the values of antioxidants of the extruded products, substituted corn products had higher antioxidant values than the un-substituted snack. Extrusion cooking process leads to decrease of compound due to alteration in their molecular structure caused by the high temperature (Altan *et al.*, 2009).

Conclusions

Extrusion process reduced the brightness and betalain of the products. Addition of beetroot flour to corn improved the antioxidant properties of the products.

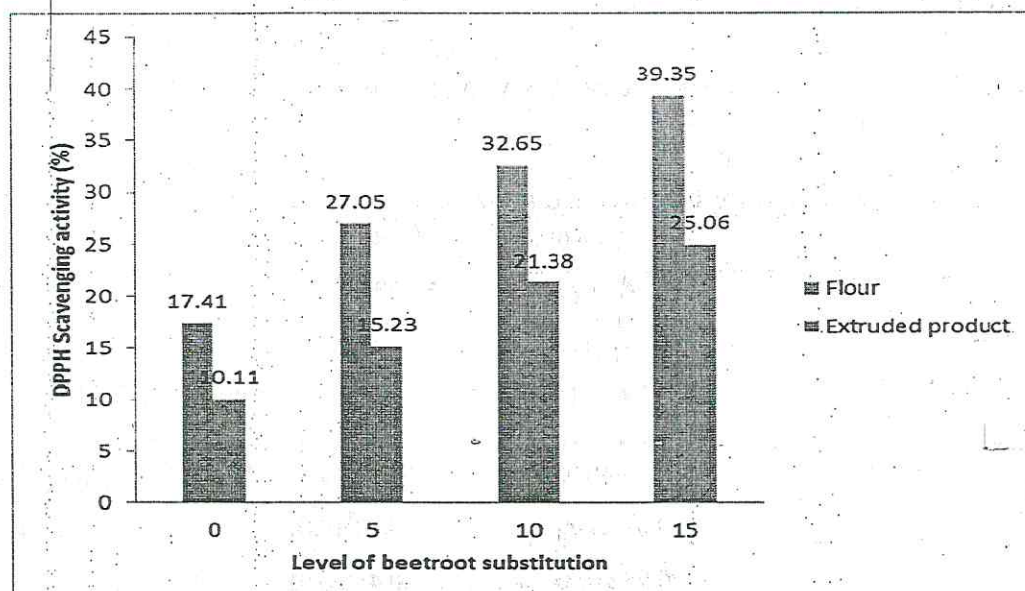


Figure 1: Effect of beetroot substitution on the scavenging activity of corn snacks

References

- Altan, A., McCarthy, K.L., Maskan, M. (2009). Effect of extrusion cooking on functional properties and in vitro starch digestibility of barley-based extrudates from fruit and vegetable by-products. *Journal Food Science*, 74(2), 77-86.
- Hsu, C.L, Chen, W., Weng, Y.M. and Tseng, C.Y. (2003). Chemical composition, physical properties, and antioxidant activities of yam flours as affected by different drying methods. *Food* 83(1), 85-92.
- Ingle, M., Ingle, M.P., Thorat, S.S., Nimbalkar, C.A. and Nawkar, R.R. (2017). Nutritional Evaluation of cookies Enriched with beetroot (*Beta vulgaris* L) powder. *Int. J. Curr. Microbial. App. Sci.*, (6), 1888-1896.
- Ibraheem, A.A., Makpou, K.R., and Shokry, A.M. (2015). Improving red color of some food products using red beet powder. *International Journal of Science and Research*, 5(12), 798-805.
- Kanner, J., Harel, S. and Granit, R. (2001). Betalains - a new class of dietary cationized antioxidants. *Journal of Agriculture and Food Chemistry*, 49, 5178-5185.
- Ravichandran, K., Saw, N.M.M.T., Mohdaly, A.A.A., Gabr, A.M.M., Kastell, A., Riedel, H., Cai, Z., Knorr, D. and Smetanska, I. (2013). Impact of processing of red beet on betalain content and antioxidant activity. *Food Research International*, 50, 670-675.
- Sacchetti, G., Pinnavaia, G.G., Guidolin, E. and Dalla, R.M. (2004). Effects of extrusion temperature and feed composition on the functional, physical and sensory properties of chestnut and rice based snack-like products. *Food Research International*, 37, 527-534.
- Sahni, P. and Shere, D.M. (2016). Physico-chemical and Sensory Characteristics of Beet Root Pomace Powder Incorporated Fibre Rich Cookies. *Intl. J. Food. Ferment. Technol.*, 6(2), 309-315
- Sandhu, K.S., Singh, N. and Malhi, N.S. (2007). Some properties of corn grains and their flours I: Physicochemical, functional and chapati-making properties of flours. *Food Chemistry*, 101, 938-946.
- Srivastava, S. and Singh, K. (2016). Physical, Sensory and Nutritional Evaluation of Biscuits Prepared by Using Beetroot (*Beta Vulgaris*) Powder. *International Journal of Innovative Research and Advanced Studies*, 3(7), 281-283

Stintzing, F. C. and Carle, R. (2004). Functional properties of anthocyanins and betalains in plants, food and in human nutrition. *Trends in Food Science and Technology*, 15, 19-38.

Tesoriere, L., Allegra, M., Butera, D., Livrea, M. A. (2004). Absorption, excretion, and distribution of dietary antioxidant betalains in LDLs: potential health effects of betalains in humans. *American Journal of Clinical Nutrition*, 80, 941-945.