Optimization of some "poundo" yam production parameters

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Abstract: Pounded yam is a very popular delicacy in Nigeria. There is need to proffer solution to the problem of its preparation which is energy consuming. This study was carried out to determine the optimum drying and blanching parameters of "poundo" yam. The "poundo" yam was produced from white yam (*Dioscorea rotunda*) using an experimental dryer. The produced "poundo" yam was subjected to proximate analysis. Optimization was carried out on the results of the analysis using regression analysis technique. Excel solver and SPSS 16.0 software packages were used for the optimization and its statistical analysis respectively. 4.79% of fat, 4.58% of protein, 3.01% of fibre, 1.50% of ash, 79.52% of carbohydrate and 1549.52 kJ (100 g)$^{-1}$ of calorie were obtained as the optimum values. For optimum nutrition retention in "poundo" yam, yam should be blanched at 100℃ for a blanching duration of 10 minutes and dried at 65℃. Moreover, the process models developed could be used to select any combination of the drying and blanching parameters that will suit the nutrition quality requirements of the prospective consumers of "poundo" yam.

Keywords: optimum drying, blanching, nutrition, "poundo" yam, processing

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1 Introduction

Yam, *Dioscorea* (*spp.*) is an important source of carbohydrate for many people of the sub-Sahara region, especially in the yam zone of West Africa (Akissoe et al., 2003). Babaleye (2003) reported that yam contributes more than 200 dietary calories per capita daily for more than 150 million people in West Africa and serves as an important source of income to the people. One of the commonly found varieties in Nigeria is *Dioscorea (D.) rotunda* (white yam) (Coursey and Booth, 1977). According to Egbe, Agbor and Treche (1984) *D. rotunda* is made up of 67% moisture. By dry weight the yam is composed of 80% starch, 7% protein, 7% minerals, 3% fibre and 1.7% lipids; 100 g of the yam give 385 kcal energy (Egbe, Agbor and Treche, 1984).

The capacity to preserve food is directly related to the level of technological development. The slow progress in upgrading traditional food processing and preservation techniques in West Africa contributes to food and nutrition insecurity in the sub-region (Aworh, 2008). Modern methods of food processing such as extrusion cooking, explosion puffing, and instantization appear to make the starch in food readily digestible.

Pounding of yam with pestle in a mortar is a special way of producing pounded yam, a special delicacy in most part of Nigeria. Pounding of boiled yam in a mortar with intermittent addition of water makes the yam softer and finer and increases the surface area upon which digestive enzymes will act, thus bringing about more rapid absorption of glucose. Pounding is a strenuous work and technological development has therefore been focussed on facilitating it. A so-called "yam pounder", essentially a powerful blending machine has been designed and constructed (Anazonwu-Bello, 1977). In 45 seconds it churns the boiled yam into the desired pounded yam. It is efficient but unfortunately is priced beyond the reach of the average African household, the limiting factor being the cost of the motor.

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Studies on pounded yam, pounded cocoyam, yam flakes, yam flour and canned yam have been reported by various researchers (Makanjuola, 1974; Onayemi and Potter, 1974; Ayernor, 1976; Ajibola, Abonyi and Onayemi, 1988). A machine for pounding yams and similar foods was developed by Makanjuola (1974) at the Department of Agricultural Engineering of University of Ile - Ife in Nigeria. It is capable of producing enough ‘fufu’ for eight adults in 45 seconds (UNIFEM, 1993). Another yam pounder was also designed and constructed by Odior and Orsarh (2008). According to Eka (1998), the actual effects of these processing methods on the nutritive value of the product have not been well elucidated.

Arising from the need to have a convenience food and reduce the drudgery associated with the preparation of pounded yam, various brands of instant yam flour are now available in West Africa since the introduction of “poundo yam”, which is no longer in the market, by Cadbury Nigeria Ltd in the 1970s (Aworh, 2008). Instant yam, on addition of hot water and stirring, reconstitutes into dough with smooth consistency similar to pounded yam. The product is so popular that considerable quantities are exported to other parts of the world, especially Europe and North America, where there are sizable African populations.

Food-Info.net (2009) reported the attempt made to commercialise production of dehydrated pounded yam by drum drying in Côte d'Ivoire in the mid-1960s, under the trade name “Foutoupret”. According to Anazonwu-Bello (1977), an improved method was developed in West Africa but when the flour was reconstituted in water, the process failed to free enough starch from the yam cells to give the desired stickiness and consistency in the “fufu”. FIIRO (2005) reported that the production process of instant pounded yam consists of simple operations, which have been mechanized. The unit operations are yam selection and weighing, washing, peeling and slicing, parboiling, drying, milling and packaging. According to Nnamdi (2010) the process of producing instant yam flour is quite simple; it involves slicing, parboiling and milling of the product to yield flour and equipment required for production can be sourced locally.

The production of pounded yam is tedious and energy consuming. And for the available alternative (poundo yam) in the market, there is little or no data on its production process. The production of this product requires some important technical information such as optimum drying and blanching parameters, so that necessary nutritional value of the product can be maintained to the lowest level during processing.

In order to run a well productive system of producing poundo yam from white yam (*Dioscorea rotundata* Poir) and to give consumers the product with the best nutrition quality, the poundo yam production parameters must be investigated and the respective optimum values must be determined. Hence, there is a need to carry out optimization of the drying and blanching parameters of poundo yam. Optimization is an act of making the best combination of elements or variables selected to synthesize a system in order to yield the best result. Optimization techniques also adjust parameters so as to attain a desired result. Gajda and Biles (1978) stated that the optimum conditions are those that produce the best, most favourable or most beneficial result from a system or process. An optimization problem requires the determination of the optimal (maximum and minimum) values of a given function called the objective function under a given set of constraints. One of the most widely used optimization techniques is the regression analysis (Olaniyan, 2006). Olayemi (1998) described a regression analysis as an attempt to measure the amount of change (in value) of the dependent variable which is derived from a unit change (in value) of the independent variable. In other words, a regression analysis is an attempt to find out, in a specific way, how one variable is related to the other and it involves a one way cause and effect relationship.

The objective of this study was to determine the optimum drying and blanching parameters for “poundo” yam production. The results of this study will make relevant technical data (optimum drying and blanching parameters) available for the present and prospective investors that would have relied on “trial and error” method in processing of yam to “poundo” yam.

2 Materials and methods

2.1 Experimental materials

The yam species used for this study is white yam (*Dioscorea rotundata* Poir). This species was considered for the study because it is abundant in the country and moreover the most preferred species for preparation of pounded yam. The tubers were procured from a yam market within Ilorin metropolis. Then the tubers were conveyed to the laboratory of Nigerian Stored Products Research Institute NSPRI, Ilorin, for investigations and laboratory analyses. The moisture content of the yam was determined to be 57% w.b.

An experimental dryer designed and constructed by Omodara (2011) was used for the drying operation. It is an electric dryer, installed with a temperature regulator. The drying cabinet measures 50 cm × 50 cm × 80 cm (with external dimensions of 56 cm × 56 cm × 86 cm), consisting of three trays. The drying chamber is double walled with 3 cm thickness fibre glass insulation. The following instruments were used in conjunction with the dryer; weighing balance, thermo-hygrometer, mercury-in-glass thermometers, measuring cylinder and Polymix experimental hammer mill. Other items employed for the experiment include stainless steel knife, plantain slicer, plastic bowls, water heater and plastic sieves.

2.2 Experimental method

The production process of "poundo" yam consists of simple operations (Figure 1) and they are yam selection, peeling, washing, cutting, flaking, blanching, drying, milling and packaging.

2.2.1 Blanching procedure

One thousand five hundred (1,500) cm^3 of water was measured with a measuring cylinder into a container, after which it was heated to 80℃. The chipped yam was poured into the heated water and timed for 10, 20 and 30 minutes respectively. The exercise was subsequently repeated for 90℃ and 100℃ heated water respectively. The chips with water were then poured into a plastic sieve in order to drain the water away and allowed to stay in the sieve for 10 minutes. The chips were then spread on the trays after which the trays were loaded into the dryer.

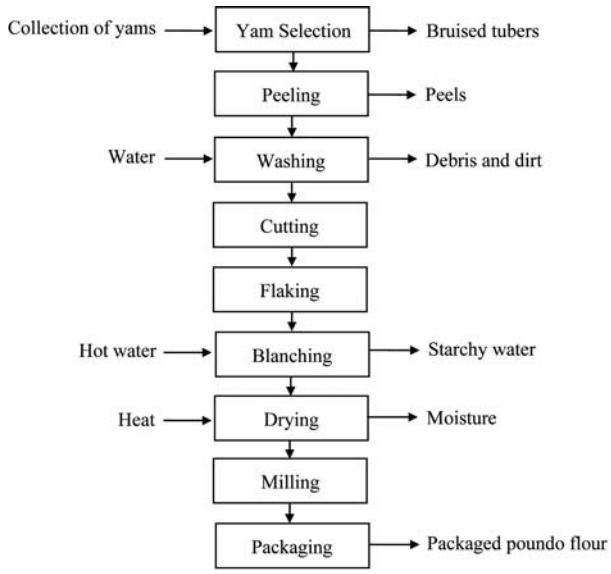

Figure 1 Flow diagram for poundo yam flour production

2.2.2 Procedure for drying operation

The dryer was pre-heated to the desired temperature of 55℃ by the means of temperature regulator while the samples were being prepared to ensure stability of the condition of the drying chamber when the yam chips will be introduced. The samples were weighed at an interval of 1 hour with a top loading balance (Snowrex counting scale SRC 5001, product of Saint Engineering Ltd, Saint House, London) with an accuracy of 1 g and measuring capacity of 5,000 g, and the weights recorded. The temperature of exhaust air from the dryer was also measured and recorded. Samples were removed, weighed and placed back in the dryer. The operation continued until the desired moisture content (12%) was reached. The procedure was repeated for the samples at 60℃ and 65℃ respectively in three replications.

2.2.3 Evaluation of the effect of drying temperature and blanching parameters on the nutritional quality of the "poundo" yam

The effects of drying temperature and blanching parameters on the nutritional quality of the dried product were evaluated by subjecting the processed product to proximate analysis. Opara (1999) gave the quality assessment parameters for white yam and its processed products as: crude protein, ash content, crude fat (lipid), fibre content, carbohydrate and calorie. The protein, ash and fibre content were determined using the procedure of AOAC (1990), and AOAC (2005) was used to determine the fat content of the product. The carbohydrate content and the calorie were determined by using the method described by FAO (1998) and Oosthuizen, Oldewage-Theron and Ebuehi (2007) respectively.

2.2.4 Optimization of the “poundo” yam processing parameters

Drying temperature at three different levels (55℃, 60℃ and 65℃) with three different blanching temperature (80℃, 90℃ and 100℃) and three different blanching durations (10 minutes, 20 minutes and 30 minutes) as independent variables for “poundo” yam production were considered. The food nutrition parameters (protein, fat, fibre, ash, carbohydrate and calorie) resulting from the combination of each of the three independent variables were taken to be dependent variables.

Just like with linear programming, quadratic programming (non-linear programming) can be formulated and solved using the solver in a spreadsheet. A solver is an *add-in* programme specifically designed to solve optimization problems. According to Rangaswamy (2010), when there are three independent variables, the multiple regression equation (Equation (1)) can be solved to get the process model. Excel Solver was used to solve the problem.

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_1x_2 + b_5x_1x_3 + b_6x_2x_3 + b_7x_1x_2x_3 \quad (1)$$

where, x_1, x_2, x_3, = various independent variables (drying temperature, blanching temperature and duration) for “poundo” yam production; Y = food nutrition parameters as dependent variables resulting from the combination of the independent variables; b_0, b_1, b_2, … = regression coefficients

The Analysis of Variance (ANOVA) of multiple regressions was carried out using the Excel Solver. Excel 2007 package was used to plot graphs of observed and predicted dependent variables for comparison. The predicted values were validated by subjecting the two sets of variables to paired-sample T-Test using SPSS 16.0 software.

3 Results and discussion

3.1 Nutritional quality evaluation

Presented in Table 1 are the respective results of the nutrition quality parameters analysis carried out on the dried samples of the “poundo” yam to investigate the level of contribution of each treatment in processing of yam into “poundo” yam. The table shows that the highest and least values of fat content are 5.86% and 3.34% respectively. The fibre and protein contents recorded ranged from 1.20% to 3.27% and 2.81% to 4.65% respectively. The highest and least values for ash content are 1.54% and 0.92%, while carbohydrate has 72.85% as its least value and 79.59% as its highest value. 1,494.95 kJ (100 g)$^{-1}$ and 1,560.43 kJ (100 g)$^{-1}$ were recorded in Table 1 as the least and the highest calorie value for the “poundo”.

Table 1 Analysis of nutrition parameters

Drying Temp. /℃	Blanching Duration /Minutes	Blanching Temp. /℃	Fat/%	Fibre/%	Protein/%	Ash/%	Carbo-hydrate/%	Calorie /kJ·(100 g)$^{-1}$
65	10	80	4.47	3.01	3.92	1.49	76.91	1526.91
		90	4.54	3.05	4.13	1.38	76.70	1529.56
		100	4.42	2.90	4.24	1.38	76.76	1527.88
	20	80	4.03	2.17	3.75	1.17	79.58	1552.28
		90	4.37	1.74	3.82	1.34	79.23	1560.43
		100	4.88	2.73	4.04	1.22	77.13	1548.12
	30	80	3.34	2.21	3.64	1.02	79.59	1524.52
		90	3.62	2.63	3.68	0.92	78.25	1513.26
		100	3.71	2.17	3.94	1.01	78.97	1533.13
60	10	80	4.31	1.57	4.15	1.54	78.33	1548.58
		90	4.56	2.11	4.24	1.42	76.17	1523.26
		100	4.82	1.64	4.09	1.46	76.69	1539.30
	20	80	3.74	2.41	3.60	1.17	77.58	1505.20
		90	3.52	1.53	3.65	1.32	78.28	1509.48
		100	4.66	1.64	3.85	1.32	77.33	1539.97

Drying Temp. /℃	Blanching Duration /Minutes	Blanching Temp. /℃	Fat/%	Fibre/%	Protein/%	Ash/%	Carbo-hydrate/%	Calorie /kJ·(100 g)$^{-1}$
		80	3.74	1.93	2.81	1.26	77.76	1494.95
	30	90	4.29	2.07	3.19	1.23	77.32	1514.73
		100	4.42	2.19	3.97	1.23	76.59	1520.48
		80	5.86	3.18	4.32	1.29	72.85	1517.96
	10	90	5.39	3.11	4.48	1.39	73.13	1507.59
		100	5.78	3.27	4.65	1.21	73.69	1534.60
		80	4.04	2.07	4.08	1.05	78.56	1541.06
55	20	90	4.32	2.19	3.94	1.14	77.81	1536.70
		100	4.53	2.04	4.52	1.15	76.66	1535.06
		80	4.58	1.40	3.86	1.23	76.83	1528.72
	30	90	4.73	1.20	3.89	1.06	76.82	1534.72
		100	5.52	1.53	4.26	0.98	75.31	1545.43

3.2 Optimization of the drying and blanching parameters of "poundo" yam production

The process models developed for the food nutrition quality parameters are presented below (Equations (2) – (7)).

$$\begin{aligned}F_{at} = {} & 498.54 - 12.68D_t - 8.499B_d - 5.617B_t + 0.08089D_t^2 + \\ & 0.169D_tB_d + 0.12D_tB_t + 0.105B_d^2 + 0.02726B_dB_t + \\ & 0.01869B_t^2 - 0.000827D_t^2B_d - 0.000567D_t^2B_t - \\ & 0.00142D_tB_d^2 - 0.000150D_tB_dB_t - 0.000273D_tB_t^2 - \\ & 0.000179B_d^2B_t - 5.41667\text{E}-05B_dB_t^2\end{aligned} \tag{2}$$

$$\begin{aligned}F_{ib} = {} & 135.52 - 4.418D_t - 10.05B_d + 1.623B_t + 0.03511D_t^2 + \\ & 0.359D_tB_d - 0.05478D_tB_t - 0.02031B_d^2 - \\ & 0.01213B_dB_t + 0.000844B_t^2 - 0.00304D_t^2B_d + \\ & 0.000493D_t^2B_t + 0.000267D_tB_d^2 + 7.5\text{E}-06D_tB_dB_t - \\ & 2.33333\text{E}-05D_tB_t^2 + 7.33333\text{E}-05B_d^2B_t + 5\text{E}-05B_dB_t^2\end{aligned} \tag{3}$$

$$\begin{aligned}P_{in} = {} & 114.97 - 2.929D_t + 3.730B_d - 1.948B_t + 0.01507D_t^2 - \\ & 0.09896D_tB_d + 0.04882D_tB_t - 0.00264B_d^2 - \\ & 0.01857B_dB_t + 0.00677B_t^2 + 0.00085D_t^2B_d - \\ & 0.000207D_t^2B_t - 8.33333\text{E}-06D_tB_d^2 - 2.25\text{E}-05D_tB_dB_t \\ & - 0.000133D_tB_t^2 + 4.08333\text{E}-05B_d^2B_t + 0.000107B_dB_t^2\end{aligned} \tag{4}$$

$$\begin{aligned}A_{sh} = {} & 5.479 - 0.667D_t - 0.648B_d + 0.2B_t + 0.00938D_t^2 + \\ & 0.01853D_tB_d + 0.00572D_tB_t + 0.01651B_d^2 - \\ & 0.005B_dB_t - 0.00346B_t^2 - 0.000173D_t^2B_d - \\ & 0.000127D_t^2B_t - 0.000123D_tB_d^2 + 6.75\text{E}-05D_tB_dB_t \\ & + 4.66667\text{E}-05D_tB_t^2 - 9.66667\text{E}-05B_d^2B_t + \\ & 2.66667\text{E}-05B_dB_t^2\end{aligned} \tag{5}$$

$$\begin{aligned}C_{ar} = {} & -644.14 + 19.85D_t + 25.91B_d + 4.243B_t - 0.124D_t^2 - \\ & 0.723D_tB_d - 0.08932D_tB_t - 0.179B_d^2 - \\ & 0.00238B_dB_t - 0.01723B_t^2 + 0.00492D_t^2B_d + \\ & 0.000107D_t^2B_t + 0.00212D_tB_d^2 + 0.000473D_tB_dB_t \\ & + 0.000367D_tB_t^2 + 0.000412B_d^2B_t - 0.000247B_dB_t^2\end{aligned} \tag{6}$$

$$\begin{aligned}C_{al} = {} & 9950.3 - 194.98D_t + 176.69B_d - 173.74B_t + 1.221D_t^2 - \\ & 7.432D_tB_d + 3.85D_tB_t + 0.917B_d^2 + 0.678B_dB_t + \\ & 0.531B_t^2 + 0.06575D_t^2B_d - 0.02309D_t^2B_t - \\ & 0.01830D_tB_d^2 + 0.00189D_tB_dB_t - 0.00641D_tB_t^2 + \\ & 0.000830B_d^2B_t - 0.00438B_dB_t^2\end{aligned} \tag{7}$$

where, F_{at}, F_{ib}, P_{in}, A_{sh}, C_{ar}, and C_{al} denote the food nutrition parameters namely, protein, fat, fibre, ash, carbohydrate and calorie, respectively; D_t is drying temperature variable; B_d is blanching duration variable; B_t is blanching temperature variable.

Analysis of Variance (ANOVA) was used to test for the existence and sufficiency of the process models, and the analysis details are as shown in Tables 2 - 7. The high value of regression coefficients (R^2) obtained from the six analyses indicates the degree at which the variations in the response variables were being explained by the set of independent variables. In addition, the high values of the regression sum of squares (RSS) as against the low values of residual sum of squares (ESS) and low value of standard error infer that the models have accounted for most of the variations in the dependent (response) variables. The models are significant at 95% confidence level. This implies that the model variables fit the data well (Iya, 2005; Olaniyan, 2006).

Table 2 ANOVA of multiple regression of fat as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	10.53	95	0.658	13.18	0.000115	16	0.955	0.882	0.223
Residual	0.499	5	0.04992			10			
Total	11.03	100				26			

Table 3 ANOVA of multiple regression of protein as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	3.644	92	0.228	7.382	0.00144	16	0.922	0.797	0.176
Residual	0.309	8	0.03085			10			
Total	3.953	100				26			

Table 4 ANOVA of multiple regression of fibre as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	7.873	85	0.492	3.640	0.02176	16	0.853	0.619	0.368
Residual	1.352	15	0.135			10			
Total	9.225	100				26			

Table 5 ANOVA of multiple regression of ash as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	0.638	93	0.03990	7.780	0.00115	16	0.926	0.807	0.07161
Residual	0.05128	7	0.00513			10			
Total	0.690	100				26			

Table 6 ANOVA of multiple regression of carbohydrate as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	70.96	90	4.435	5.813	0.00380	16	0.903	0.748	0.873
Residual	7.630	10	0.763			10			
Total	78.59	100				26			

Table 7 ANOVA of multiple regression of calorie as a function of drying and blanching parameters

Source	SS	SS%	MS	*F*	*F* Signif	df	R^2	Adjusted R^2	Std. Error
Regression	4425.3	70	276.58	1.427	0.289	16	0.695	0.208	13.92
Residual	1938.2	30	193.82			10			
Total	6363.5	100				26			

The optimum values of the processing parameters of “poundo” yam production are presented in Table 8. The Table shows that in order to maximize fat content of “poundo” yam, a drying temperature of 65℃, blanching duration of 16.27 minutes and blanching temperature of 100℃ should be combined to give the optimum fat content of 4.79%. For protein, a combination of 55℃ drying temperature, 10 minutes blanching duration and blanching temperature of 100℃ resulted to the optimum value of 4.58% of protein. An optimum value of 3.01% was got for fibre at a drying temperature of 65℃, blanching duration of 10 minutes and blanching temperature of 100℃. The ash content of the “poundo” yam has 1.50% as its optimum value, and this corresponds to a combination of 63.54℃ drying temperature, 10 minutes blanching duration and 80℃ blanching temperature. A drying temperature of 65℃, blanching duration of 26.13 minutes and blanching temperature of 80℃ should be selected to give the optimum carbohydrate content of 79.52%; while calorie requires a drying temperature of 65℃, blanching duration of 20.21 minutes and blanching temperature of 100℃ to give the optimum value of 1,549.52 kJ (100 g)$^{-1}$.

Table 8 Optimum values for drying, blanching and nutrition quality parameters of "poundo" yam

Nutrition quality parameters	Optimum drying Temperatures /℃	Optimum blanching duration (Minutes)	Optimum blanching Temperatures /℃	Optimum value
Fat	65	16.27	100	4.79 %
Protein	55	10	100	4.58 %
Fibre	65	10	100	3.01 %
Ash	63.54	10	80	1.50 %
Carbohydrate	65	26.13	80	79.52 %
Calorie	65	20.21	100	1549.52 kJ (100 g)$^{-1}$

The measured outputs of the "poundo" yam nutrition quality parameters (observed value) were compared with the predicted values from the developed process model. The two sets of data were plotted on the same graph to see how favourably compared they are. Figures 2 - 7 showed that all the predicted outputs compared favourably with the measured outputs as little or no difference could be noticed in the trend of the pair of curves in all the figures. The results of comparison of the observed and the predicted curves for all the nutritional quality parameters obtained as shown in Figures 2 - 7 indicating that the correlation coefficient numerically varies between –1 and 1 and reflecting negative, zero or positive correlation between the model and the sample data set (Obi, 1986). The values presented in Figures 2 - 7 can justify the choice of arbitrary values of temperature range of 70 - 80℃ recommended by Ayodeji and Abioye (2011) as yam parboiling temperature during evaluation of parboiling machine for poundo-yam flour processing plant.

In order to validate the predicted outputs, both the observed and predicted outputs were subjected to paired sample t-test. From Table 9 the level of correlation was 0.977, 0.924, 0.960, 0.962, 0.950 and 0.834 for fat, fibre, protein, ash, carbohydrate and calorie respectively. All of them gave high level of correlation. These high levels of correlation show that the predicted values compared favourably with the observed values. The statistical significance test is done to show how adequately the sample data test from the predicted and observed values compared favourably for a given R^2 significance level when looking up for the probability (significance level) in a table of "t" values (Snedecor and Cochran, 1980). Peter, Olabanji and Kanisuru (2012) noted that the blanching temperature blanching time and drying temperature are the essentials parameters in designing of a process plant for the production of poundo yam but they could only based their design calculation on assumption of blanching for some minutes depending on the thickness of the slices and drying for few hours. The predicted and observed values shown in Figures 2 to 7 have been indicated to compare favourably and followed the procedure highlighted by Snedecor and Cochran (1980). Therefore, the models are validated and can be used to select the best production parameters for optimal production of "poundo" yam.

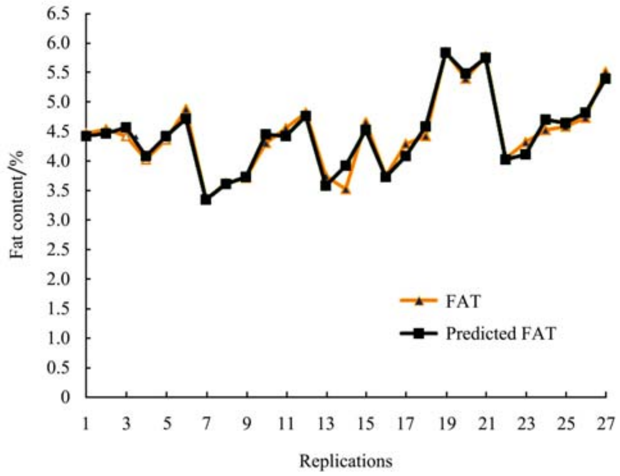

Figure 2 Comparison of the observed and predicted output of fat in "poundo" yam

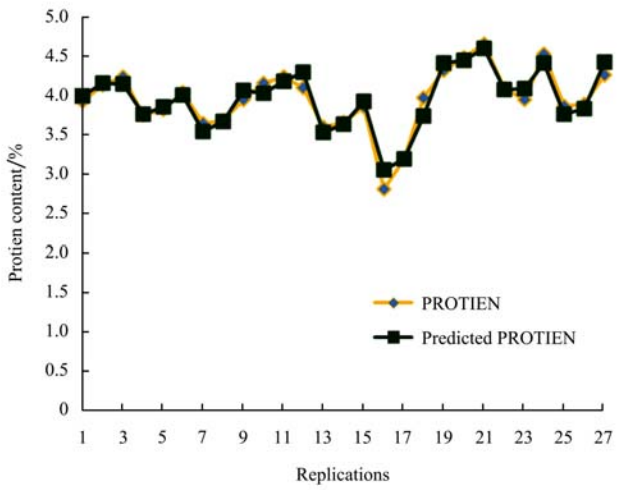

Figure 3 Comparison of the observed and predicted output of protein in "poundo" yam

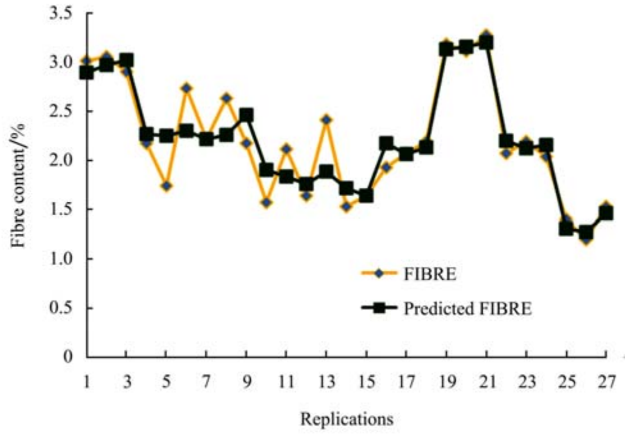

Figure 4 Comparison of the observed and predicted output of fibre in “poundo” yam

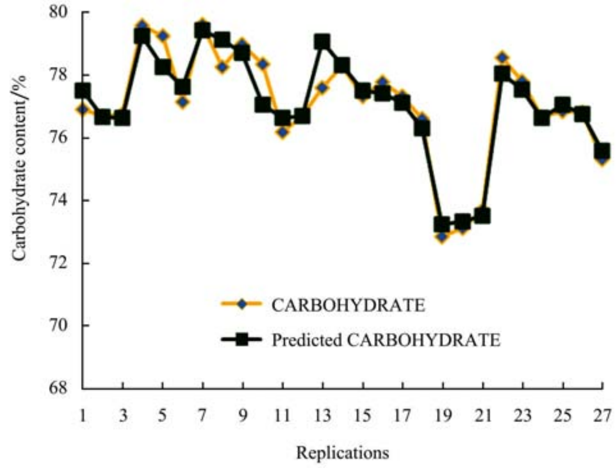

Figure 6 Comparison of the observed and predicted output of carbohydrate in “poundo” yam

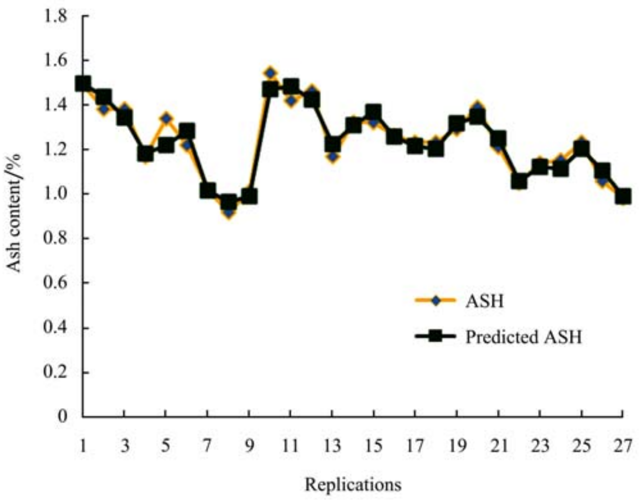

Figure 5 Comparison of the observed and predicted output of ash in “poundo” yam

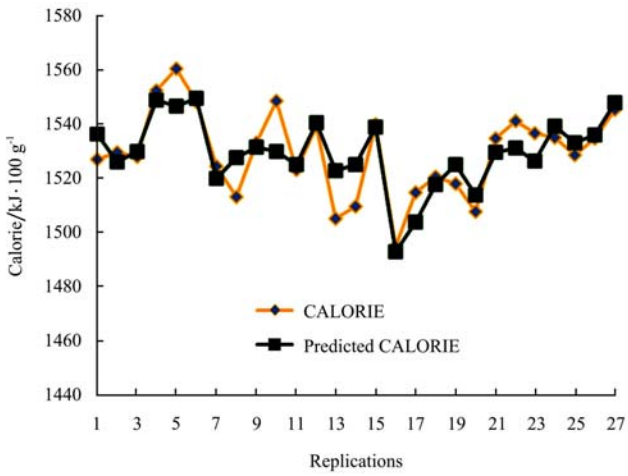

Figure 7 Comparison of the observed and predicted output of calorie in “poundo” yam

Table 9 Paired sample t-test of the observed and predicted values of the "poundo" yam nutrition quality parameters

		Paired Differences					t	df	Correlation
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Observed Fat - Predicted Fat	-0.00011	0.13852	0.02666	-0.05491	0.05469	-0.004	26	0.977
Pair 2	Observed Fibre - Predicted Fibre	0.00000	0.22800	0.04388	-0.09020	0.09020	0.000	26	0.924
Pair 3	Observed Protein - Predicted Protein	0.00004	0.10893	0.02096	-0.04305	0.04313	0.002	26	0.960
Pair 4	Observed Ash - Predicted Ash	-0.00004	0.04443	0.00855	-0.01761	0.01754	-0.004	26	0.962
Pair 5	Observed C/Hydrate - Predicted C/Hydrate	-0.00111	0.54134	0.10418	-0.21526	0.21304	-0.011	26	0.950
Pair 6	Observed Calorie - Predicted Calorie	-0.00074	8.63062	1.66096	-3.41490	3.41342	0.000	26	0.834

4 Conclusions

The drying temperature, blanching duration and blanching temperature were identified as processing conditions that affect the nutrition quality requirements for production of “poundo” yam produced from white yam (*Dioscorea rotunda*).

The nutrition quality requirements for production of “poundo” yam produced from white yam (*Dioscorea *rotunda*) that were investigated include fat content, protein, fibre, carbohydrate and calorie.

Sets of process models were developed to select any combination of the drying and blanching parameters that will suit the nutrition quality requirements for production of “poundo” yam produced from white yam (*Dioscorea rotunda*).

Consequently, for optimum retention of the nutrition quality parameters in “poundo” yam production from white yam (*Dioscorea rotunda*), yam should be blanched at 100℃ for a blanching duration of 10 minutes and dried at 65℃ drying temperature.

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