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FACTORS ASSOCIATED WITH ADOPTION OF INDIGENOUS BISCUIT PROCESSING TECHNOLOGY BY MOTHERS OF SCHOOL-GOING CHILDREN IN OGUN STATE, NIGERIA

Ayansina SO[1], Adeola AA[2]*, Fasoyiro SB[3] and SA Famakinde[4]

Abiodun A. Adeola

*Corresponding author email: adeolaroni@yahoo.com

[1]Department of Agricultural Administration, Federal University of Agriculture, Abeokuta, Nigeria

[2]Food and Nutrition Research Programme, Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Nigeria

[3]Product Development Programme, Institute of Agricultural Research and Training, Obafemi Awolowo University, Ile-Ife

[4]Livestock Research Programme, Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Nigeria

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ABSTRACT

Wheat is the conventional flour in biscuit manufacture. However, the use of wheat is not economical due to the fact that huge foreign reserve is used in its importation in Nigeria. In addition, wheat-based foods are associated with celiac disease, hence the use of non-wheat crops like tubers and legumes in biscuit processing is desirable. A previous study had developed a nutritionally improved biscuit from underutilized crops, such as sweet potato, cooking banana and pigeon pea. The present study examined factors associated with adoption of the indigenous biscuit processing technology using non-wheat flours by mothers of school going children in Ogun State, Nigeria. A-multistage sampling procedure was utilized to select 120 respondents from the list of 1,123 registered farmers in 10 extension blocks in Ogun State. A questionnaire was used to collect data on the socioeconomic characteristics of respondents. Respondents were taught the various stages of biscuit processing through demonstration. Knowledge about the various stages of biscuit processing was measured on a 5-point Likert Scale. The five points used were: extremely understood, moderately understood, somewhat understood, slightly understood and not understood. Level of adoption indicates the psychological stages that an individual passes through before making a final decision to use a particular innovation. Adoption Level was thus measured on Knowledge, Persuasions, Decision, Confirmation and Continuation decision. Data were analyzed using Analysis of Variance, Chi square, and Pearson Product Moment Correlation. Results revealed the mean age of respondents to be 40.35 ± 10.33 years. Most respondents were traders, and the highest educational qualification was National Diploma (2.5%). The main sources of agricultural information were radio (64.2%) and extension agents (60%). There were high adoption rates in baking/production (87.7%) and flour blending (85.5%). Reasons for technology adoption were affordability (80.8%), availability of ingredients (81.7%) and relative advantage (80.8%). Adoption of technology was associated with age ($r = 0.284$, $p < 0.05$), quality of technology delivery ($r = 0.267$, $p < 0.05$), marital status ($\chi^2 = 1.081$, $p < 0.05$) and membership of association ($\chi^2 = 12.055$, $p < 0.05$). In conclusion, effective adoption of technology could be achieved among young married mothers.

Key words: Adoption, biscuit, wheat, non-gluten flour, sweet potato, cooking banana, pigeon pea, nursing mothers

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INTRODUCTION

Convenience foods have gained such a global prominence that they serve as possible means of supplying society's nourishment [1]. These foods could come in the form of hand-held snacks or full meals. The adoption of urban lifestyle by Nigerians has resulted in the popularity of convenience foods by all age groups [1]. Biscuits are flour-based, shelf- stable crispy convenience foods. The use of composite flour obtained from indigenous crops in biscuit manufacture is especially desirable in developing economies, such as Nigeria. Apart from conserving the nation's foreign reserve, such flours have the potential of contributing positively to the health of consumers. In recent times, the linkage of wheat-based foods with celiac disease has generated concern, and the use of non-wheat crops such as roots/tubers, legumes and fruits as substitutes to wheat is being advocated [2]. Sweet potato (*Ipomea batatas* Lam.) is an important starchy crop in the world, especially in developing countries [3]. It could be regarded as a climate-smart crop due to its ability to tolerate high temperatures, low fertility soil and drought conditions [3]. It is rich in starch, vitamins, minerals, dietary fiber and bioactive compounds, but low in protein and lipid. Sweet potato possesses antioxidant, antitumor, anti-inflammatory and anti-diabetic properties [3]. Flour from sweet potato has been suggested as a substitute to wheat flour, to lower cost of baked goods and also reduce imports of wheat [4]. Products of sweet potato flour include bread, doughnut, biscuits, muffins, breakfast cereals and complementary foods [5, 6].

Cooking banana was introduced in Nigeria by the International Institute of Tropical Agriculture in order to mitigate the menace of black sigatoka, a fungal leaf spot disease [5]. Other desirable agronomic qualities of cooking banana include lodging/wind resistance, drought tolerance, early ratooning capacity, short duration, as well as high bunch yield [5]. All of these qualities make cooking banana survive extreme conditions which are not conducive for plantain and desert banana. In south west Nigeria, cooking banana is known as 'ogede bello'. It has been reported to possess similar pulp weight as some cultivars of plantain [6]. It is still underutilised because of its limited application in product development, although Falade and Oyeyinka [6] reported that its flour has potential as a bakery ingredient.

Pigeon pea [*Cajanus cajan* (L.) Millspaugh] is the sixth most important legume crop in the world [7]. However, in West Africa, pigeon pea is a minor crop although it plays a key role in the sustenance of smallholders in Benin, Nigeria and Ghana [7]. Pigeon pea is desirable in alleviating malnutrition in developing countries as the mature seed has been reported to contain 18.8% protein, 53% starch, 2.3% fat, 6.6% crude fibre, 120.8 mg/100g calcium, 122.0 mg/100g magnesium, 3.9 mg/100g iron and 2.3 mg/100g zinc [8]. As a perennial shrub, pigeon pea is advantageous over annual legumes in a number of ways such as high tolerance of drought stresses, high biomass productivity, soil fertility improvement, adaptability to wide range of soil types and textures (though it grows best on well-drained medium heavy loams), possibility of several harvests, untapped potential for improvement both in quantity and quality [7, 9]. Pigeon pea is a versatile crop grown primarily as a vegetable in some parts of the world, Africa inclusive [9]. In rural parts of Nigeria, it is cooked and eaten just like cowpeas. Pigeon

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pea has been reported to improve the nutritional value of food formulations such as noodles, pasta, complementary foods and baked goods [9, 10].

Composite flours of sweet potato, cooking banana and pigeon pea contain attributes that are desirable for alleviating malnutrition in Nigeria and developing new food formulations [4]. Biscuits produced from the composite flour contained higher protein, total dietary, and energy contents than the conventional wheat flour. The process technology for the biscuit involved blending of ingredients to form soft dough, kneading, rolling, cutting, baking, cooling and packaging. The method of the biscuit manufacture was designed for home production by the rural dwellers. In order to exploit the potential of the improved biscuit in promoting health, there is need to transfer the process technology to consumers.

Adoption is a concept which refers to the acceptance and continuous decision to use an idea or practice by a single unit of a potential audience [11]. In the developing world, new agricultural technologies are predominantly characterized by low and slow adoption, adding to the frustration of researchers, development practitioners, policy makers and donors [12]. The compatibility of the new agricultural technologies with existing resources, practices and technologies influences adoption. The adoption process involves a sequence of sub-decisions on when to try out the new technology, when to adopt, the intensity of adoption, and whether or not to fully replace the old with the new technology [12]. The processes of adoption involve such stages as Knowledge, Persuasion, Decision, Confirmation and Continuation, Decision. The adoption of improved technology is influenced by various factors such as personal characteristics, traditional beliefs, ease of the technology, institutional and socio-economic factors [11]. Adoption of improved technology may impact positively on the socio-economic aspects and nutritional wellness of rural dwellers [13]. Studies on adoption of agricultural technology provide bases for improving the efficiency of technology generation, assessing the effectiveness of technology transfer as well as its suitability to local environment [5]. It is against this backdrop that this study was evolved to assess adoption of improved non-gluten biscuit processing technology by mothers of school-aged children in Ogun State.

METHODOLOGY

Study sites

The study was carried out in Ogun State, Nigeria, particularly under the jurisdiction of Ogun State Agricultural Development Programme (OGADEP) that came into existence in February 1986. It is one of the first seven Multi-State Agricultural Development Projects (ADPs), which took off effectively in 1987 [21]. Like other ADPs in Nigeria, OGADEP enjoys the tripartite funding of the World Bank, the Nigerian Federal Government and the Ogun state Government. For administrative purposes, Ogun State is divided into four zones: Abeokuta, Ilaro, Ijebu-ode, and Ikenne. Each zone is managed by a Zonal Extension Officer. Each Local Government of the State is also divided into two block- offices and each block office into cells. Finally, respondents were selected from 16 cells out of 54 which represented about 30% of the total cells in the study area. Each block is controlled by a Block Extension Supervisor and each cell

by a Village Extension Agent. The ADP as an organisation is run through a management system giving room for effective implementation of adoption process and other extension services which are often conceptualized as an educational process which promotes learning. The ADP makes use of combination of findings in biological sciences research and principles of social sciences to effect desirable changes in knowledge, skills, attitudes and practices of farmers in and out of school setting.

Respondents Sampling Process

A three- stage sampling procedure was employed to select respondents among the mothers of school-going children in Ogun State [14]. In stage one, as depicted in table 1, there was a purposive selection of ten (10) extension blocks from twenty (20) Local Government Areas in the four (4) existing zones (Abeokuta, Ikenne, Ijebu-ode and Ilaro) of the State. In the second stage, 16 (28.1%) of the 57 cells in the State were randomly selected; five from Abeokuta, two from Ikenne, five from Ijebu-ode and four from Ilaro. Finally, 30 mothers of school-going children were selected from 10, 6, 10 and 6 villages (Cells) in Abeokuta, Ikenne, Ijebu-ode and Ilaro zone respectively. Thus, a total number of one hundred and twenty (120) respondents selected from the list of 1,123 on the ADP farmers' register in thirty-two (32) villages were trained and interviewed for the delivery and adoption of the process technology of gluten-free biscuit.

Data Collection Instruments

The instrument utilized for the purpose of this research work was a questionnaire. The questionnaire used in this study consisted of about 55 questions separated into six sections: Section A was composed of eight socio-economic variables related with the theme of the study, and Section B was composed of seven items on the technology knowledge index of flour production which sought how well respondents understood the processing technology.

Section C sought information on the adoption indices of improved biscuits/flour on the various stages of production of banana, pigeon pea, sweet potato blended flour and final baking/ production processes. In section D, information was sought on reasons for the technology adoption which was captured on Cheap/Economical, Relative advantage, Production Mechanism/Divisibility, Availability of material, Simplicity of the method, Compatibility with Culture. In Section E, Constraints to adoption was measured on inadequate finance/Capital investment, High cost of baking ingredients, Non-acceptability/Palatability of the product, Inadequate/high cost of required facility and complexity to baking technology respectively.

In order to ascertain the validity of the instrument used for data collection for the study, the instruments' content was securitized through an expert's judgment, and to check the overall reliability of the questionnaire it was subjected to the Cronbach's Alpha of internal consistency [19]. The value obtained for the Cronbach's Alpha coefficient was 0.78, which proves that the reliability of the instrument used for this investigation was high enough to produce a valid and reliable result.

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Knowledge acquisition index of the processing technology

Knowledge acquisition index is responsible for identifying, acquiring and storage of new knowledge that will be useful in decision making process to undertake a particular task. It specifically refers to series of tasks required to be performed for accomplishment of a process of a technology which in this study are: blending of composite flour, kneading, rolling into sheet, cutting into shapes, baking, cooling and packaging. The modified method of Ogundile [15] was used. Likert Scale self-designed questionnaire was used to collect the data where 'Extremely Understood' = 5, 'Somewhat Understood' = 3 and 'Slightly Understood' = 1. The mean score is 2.5 meaning that any score above this is held to be significant.

Adoption index and Reasons for the process technology

This was done according to Jibowo [16]. Adoption Index is the series of psychological stages which an individual passes in the process of making a final decision to utilize a particular innovation. This psychological stage runs through the path of knowledge, persuasion, decision to use, and confirmation and continuation of the technology operation while the obvious reasons were also used to test why they adopted the technology. On a check back on the technology delivered to the respondents, some months after the technology delivery to the mothers of school-age children, an evaluation process was staged to examine the adoption status of the technology.

Design and Data Analysis

The study was a survey type aiming at analysis, interpretation and empirical generalization of the data collected from the specified population of mothers of school going children. Specifically, it examined the distribution, incidence, and interaction of study variables so as to achieve the objectives of the study. In the quest to achieve this, a quantitative research methodology was placed on the method of surveys and application of statistical test with SPSS was utilized. Furthermore, a descriptive analysis such as frequency counts, percentages, means ($\bar{X}$) and measure of variability were utilized to present the results on descriptive levels. Chi-square and Pearson Product Moment Correlation (PPMC) analysis were employed to assess the relationship of the adoption of the technology with marital status, sources of information, membership of association, age and knowledge levels of the respondents.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

In order to describe the socioeconomic characteristics of the respondents, data were captured and presented on variables such as age, marital status occupation characteristics, educational level, sources of agricultural information and income level. Participation and utilization of improved practices and new technologies vis-à-vis development has been a subject of discussions in many instances most especially among the farmers and women folk in the rural settings [20]. The adoption of innovation particularly is mostly influenced by various factors such as personal characteristics, traditional beliefs, simplicity of the technology, institutional and socioeconomic factors [11]. As further shown on table 2, 38.3% and 23.0% of the respondents were between 31-40 and 41-50 years, respectively. The mean age of the

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respondents was 40.3 years (SD=10.33). This is an indication that respondents were still agile and able individuals expected to be favourably disposed to change, vulnerable to knowledge acquisition and hence adoption of innovation such as non-gluten biscuit processing technologies [17,18]. Majority (63.3%) of the respondents were married and 33.3% were single mothers. Results on occupation characteristics revealed that 35.8% were traders, 20.0% engaged in sewing/weaving while 19.2% and 8.3% earned livelihood in farming and catering services. As further depicted in table 2, 28% were school certificate holders, 10.8% of the respondents possessed either Ordinary National Diploma or National Certificate of Education while 2.5% and 8.0% had bachelor and post graduate degrees respectively. According to table 2, important sources of agricultural/home making information were radio, extension agents, farmers around, other sources included researchers and neighbours, and cooperative/social club. The monthly income of the majority (52.5%) of the respondents varied between ₦30,000 (USD 62.5) and ₦40,000 (USD 83.3).

Knowledge acquisition index of the processing technology

As shown on table 3, results revealed that rolling into sheet ($\bar{X}$=3.87) was the most understood task followed by cooling of the final product ($\bar{X}$=3.84). Other stages as understood were cutting into different shapes ($\bar{X}$=3.70), kneading ($\bar{X}$=3.60), and blending of the composite flour ($\bar{X}$=3.57) accordingly. These results indicated that there was a high understanding of the various tasks involved in the technology process among the respondents (Mothers of School- going Children). The respondents embraced the innovation with interest and all enthusiasm probably because it directly affected the welfare of their children and also the possibility of commercializing the product for their family upkeep [22].

Adoption index and Reasons for the process technology

As depicted on table 4a, adoption process was operationalized on knowledge, persuasion, and decision to use, confirmation and continuation of the technology operation. Results revealed that 85.8% of the respondents adopted the technology and continued the method involved in production of banana, pigeon pea, sweet potato flour, and blending of composite flour while 87.7% adopted and continued the use of the method in baking and actual biscuit production process. Furthermore, reasons for adoption of the technology were also sought among the respondents (table 4b). Results revealed that 81.7% of the respondents adopted the technology due to availability of material/ingredient involved and simplicity of the methods. Other reasons behind the high adoption were cheap/economical (80.8%), relative advantage/nutritious (80.8%), production mechanism/divisibility (79.2%) and compatibility with their culture (75.0%). In this regard, it is affirmed that the respondents were favourably disposed to the technology and continuous utilization of the innovation because when the technology was being introduced to them, it was observed that they were happy and very interested to have it in order to improve the welfare of their children and probably making money from its commercial production in the future [22].

Testing of Research Hypotheses

Hypotheses were set for the study in order to establish the relationships between the dependent (Adoption of study technology) and independent variables such as

socioeconomic characteristics of the respondents, knowledge level at the various stages involved in the technology processing and production. In doing this Chi-square analysis, PPMC and ANOVA were employed to test the relationships among the variables and the technology adoption.

As shown on table 6, Chi-square analysis revealed a significant relationship ($p < 0.05$) between marital status (χ^2=1.081), membership of association (χ^2= 12.055) and adoption of the technology. This implies that being a married individual and belongingness to some associations will positively enhance and assist quick adoption of innovation. Table 7 revealed positive and significant association ($p < 0.05$) between age of the respondents ($r = 0.284$), quality of technology delivery process ($r = 0.267$) and adoption of the technology. This result agreed with Nwaru [17] who found that middle age individuals among rural dwellers are more receptive to innovative ideas and hence, more likely to adopt new technologies than old farmers. Okonkwo *et al*. [18] also stated that technology adoption and utilization increase with quality and varieties of training delivery methods by the scientists and agricultural extension officers involved.

CONCLUSION

The overall development of any nation requires a dynamic and systematic generations of useful ideas and appropriate technologies. And for such to be useful, there is a need for its proper adoption among the target population. Adoption of appropriate technology is expected to make a positive impact on the socioeconomic status of the respondents, human dietary processing and the overall development of rural dwellers. Tested hypotheses revealed that marital status, age, membership of association and quality of technology delivery process enhanced utilization of non-gluten biscuit processing technology. There were also differences in the level of adoption of the technology among the respondents in the different zones of the study area. It is however recommended that effective delivery of the biscuit technology could be achieved among the married young mothers. Extension agents, researchers and all change agents are enjoined to be more proactive in further researches on food science and agricultural production systems. These will go a long way to improve the overall status and wellbeing of the rural dweller through a vibrant and result oriented extension delivery process.

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Table 1: Sample frame of respondents

ADP ZONES IN OGUN STATE	No of Blocks	50% of Block Selected	No of Cells*	30% of Cell Selected	No of Selected Villages*	Selected Respondents
Abeokuta	6	3	18	5	10	30
Ikenne	4	2	8	2	6	30
Ijebu-Ode	6	3	15	5	10	30
Ilaro	4	2	13	4	6	30
Total	20	10	54	16	32	120

Source: - Field Survey, 2018
*Random and Purposive methods were used in the selection of cells and villages

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Table 2: Socio-demographic characteristics of respondents

Variables	Frequency	Percentages (%)	Mean/ S.D N=120
Age (actual age in years)			
Less than or equal to 30	23	19.2	
31 – 40	46	38.3	40.35/10.33
41 – 50	28	23.3	
51 – 60	18	15.0	
61 – 70	5	4.2	
Marital Status			
Single Mother	40	33.3	
Married	76	63.3	
Divorced	4	3.4	
Occupation			
Farming	23	19.2	
Agro-processing	4	3.3	
Trading	43	35.8	
Sewing/Tailoring/Weaving	24	20.8	
Catering	10	8.3	
Fishing	1	8	
Small chop biz	1	8	
Student	10	8.3	
Teaching	4	3.3	
Educational level			
No formal education	25	20.8	
Primary education	41	34.2	
Secondary education	34	28.3	
Teacher's grade test	3	2.5	
Ordinary National Diploma/National Certificate of Education/Higher National Diploma	13	10.8	
Bachelor degree	3	2.5	

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Higher degree	1	8.0	
***Source of agricultural/home making information**			
Radio	77	64.2	
Extension agent	72	60.0	
Researcher/institutes	65	54.2	
Neighbours	65	54.2	
Farmers around	69	57.5	
Membership of social group			
Co-operative	36	30.0	
Professional association	26	21.7	
Community association	21	17.5	
Social club	36.	30.0	
Pressure group	1	8	
Income Level in Naira (₦)			
Less than 30000	18	15.0	
30000 – 40000	63	52.5	
41000 – 50000	35	29.2	
51000 – 60000	4	3.3	

*Multiple responses

Table 3: Knowledge acquisition index of the indigenous biscuit technology process

Biscuit	EU (%)	MU (%)	SOU (%)	SLU (%)	NU (%)	Mean
Blending of composite flour	56(46.7)	11(9.2)	14(11.7)	23(19.2)	16(13.3)	3.57
Kneading	51(42.5)	18(15.0)	16(13.3)	22(18.3)	13(10.8)	3.60
Rolling into sheet	58(48.3)	10(8.3)	12(10.0)	29(24.2)	11(9.2)	3.87
Cutting into shapes	61(50.8)	10(8.3)	12(10.0)	26(21.7)	11(9.2)	3.70
Baking of biscuits	56(46.7)	10(8.3)	30(25.0)	23(19.2)	1(0.8)	3.81
Cooling of the final product	63(52.5)	18(15.0)	9(7.5)	17(14.2)	13(10.8)	3.84
Packaging in polythene	85(70.8)	21(17.5)	6(5.0)	6(5.0)	2(1.7)	4.51

EU (Extremely Understood); MU (Moderately Understood); SOU (Somewhat Understood); SLU (Slightly Understood); NU (Not Understood)

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Table 4: Adoption index of the indigenous biscuit technology

Improved Biscuit	Knowledge (%)	Persuasion (%)	Decision (%)	Confirmation (%)	Continuation (%)
Banana flour production	120(100.0)	120(100.0).	105(87.5)	103(85.8)	103(85.8)
Pigeon pea flour production	120(100.0)	120(100.0)	103(85.8)	103(85.8)	103(85.8)
Sweet potato flour production	120(100.0)	120(100.0)	103(85.8)	103(85.8)	103(85.8)
Blending of flour	120(100.0)	120(100.0)	103(85.8)	103(85.8)	103(85.8)
Baking/production	120(100.0)	120(100.0)	104(86.7)	104(86.7)	104(87.7)

Table 5: Reasons for adoption of the indigenous biscuit technology

Reasons	Yes (%)	No (%)
Cheap/economical	97(80.8)	23(19.2)
Relative advantages (Nutritious)	96(80.8)	24(20.0)
Production mechanism/divisibility	95(79.2)	25(20.8)
Availability of materials involved	98(81.7)	22(18.3)
Simplicity of method involved	88(73.3)	32(26.7)
Compatibility with culture	90(75.0)	30(25.0)

Table 6: Test of association between socio-demographic characteristics of the respondents and the adoption of the indigenous biscuit technology process

Variables	X –value	Df	P -value
Marital status	1.081	3	0.002
Occupation	7.233	8	0.512
Educational level	2.538	6	0.864
Radio	1.085	1	0.297
Extension agent	1.382	1	0.240
Researcher	2.151	1	0.142
Neighbour	9.403	1	0.026
Farmers around	0.421	1	0.517
Membership of association	12.055	4	0.017

S= Significant at $p < 0.05$; NS= Not significant at $p > 0.05$

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Table 7: Correlation test of significance between age, income, technology of delivery and Adoption of indigenous biscuit Technology Process

Variables	R- value	P –value
Age	0.284	0.002
Income level	0.093	0.315
Technology delivery	0.267	0.006

S= Significant at $p < 0.05$; NS= Not significant at $p > 0.05$

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