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Knowledge and attitude of farmers towards the adoption of pro-vitamin A bio-fortified cassava in Anambra State, Nigeria

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ABSTRACT

This study sought to determine Knowledge and attitude of farmers towards the adoption of pro-vitamin A bio-fortified cassava (PVABC) in Anambra State, Nigeria. Multistage sampling procedures were used in selecting ninety-six cassava farmers. Structured interview schedule, key informant interviews and personal observation were employed for data collection. The data were analysed using descriptive statistics and factor analysis. The study revealed that a greater percent of the farmers obtained information on PVABC production from many sources but preferred fellow farmers for the information. The majority of farmers had high knowledge as well as positive attitudes to PVABC production. Perceived constraints to the adoption of PVABC were organised into environmental constraint, cost and production constraints, labour constraints and marketing constraint. Thus, the study recommends that government and non-governmental agencies should look into these constraints especially provision of financial support to research institutes to multiply pro-vitamin A bio-fortified cassava planting materials and distributes them across to the farmers within the country so as to produce enough for consumption.

Keywords: Bio-fortified cassava, pro-vitamin A, adoption, knowledge, attitude, Nigeria

1. INTRODUCTION

Cassava (*Manihot esculenta)* is a staple crop found in the family of *Euphorbiaceae* that produces tapered edible roots (Sahel, 2016). It is a hardy crop that is extremely adaptable to harsh weather conditions like drought and can grow well on soils of low fertility (Adeola, Ogunleye, & Bolarinwa, 2017). As the most important crop by production and second most important crop by consumption, the edible tuber is the most desirable product (Sahel, 2016). The tubers produced are consumed locally as traditional meals in different processed food forms like fufu, cassava flour, cassava chips and garri (Davidson, Ene-Obong & Chinma, 2017). It is also used industrially in the production of starch, confectionaries and adhesive materials. The significant role of cassava in poverty alleviation, food security and rural employment cannot be overemphasized.

Globally, cassava is mostly grown in the tropical countries of Asia, Latin-America and Africa (Alene *et al*., 2018). Africa is the topmost producing region accounting to over 30% of the world total cassava production and Nigeria, in particular leading the production with 20% of the total world output (Chetchuda, 2017). Different varieties of cassava produced in Nigeria are usually white or milky white in colour and contains no pro-vitamin A (Oparinde *et al*, 2016). Vitamin A is an essential nutrient in every diet considering its numerous roles in preventing visual impairment, promoting growth and general wellbeing. Its lack in diets has been reported to have been associated with the cause of serious health problems such as night blindness and some morbidities as well as mortality in Nigeria (World Health Organization, 2017).

Addressing the menace of vitamin A deficiency with bio-fortification technology is not only ideal but crucial and ultimate. Bio-fortification aims to improve nutritional quality of food crops through agronomic practices, conventional plant breeding, or modern biotechnology (Onyeneke, Amadi & Anosike, 2019). It differs from conventional fortification in that bio-fortification increases nutrient levels in crops during plant growth rather than through manual means during processing of the crops. Bio-fortification may therefore represent the best possible way to improve nutritional value of crops for larger populace where supplementation and conventional fortification activities may be difficult to be implemented and/or limited (Vigneshwaran, Saud, Borah & Sekhar, 2020). This biotechnology is mostly targeted in crops and commonly observable in staples such as, maize, rice, wheat cassava, potatoes, legumes and fruits (Garg *et al.,* 2018). Cassava as a staple crop is proven to be a promising crop for bio-fortification of vitamin A dietary intake considering the important role of cassava in the Nigerian diets (Ilona, Bouis, Palenberg, Moursi & Oparinde, 2017). Bio-fortified cassava varieties are yellow in colour as a result of their high beta carotene content (pro-vitamin A) and are often called "yellow cassava" (Adeola *et al*., 2017). The cultivars also combined all desirable traits of the other cultivars such as early bulking, disease resistance, high dry matter content, high leaf retention in dry season (i.e. showing high drought tolerance) and gives high quality flour for making confectionaries (Olatade, Olugbire, Adepoju, Aremu & Oyedele, 2016).

Adoption of pro-vitamin A bio-fortified cassava (PVABC) is a necessity to combat vitamin A deficiency in most diets. Adoption is the degree of use of a new technology in a long-run equilibrium when the farmer has full information about the potentials of the new technology (Melesse, 2018). It does not happen spontaneously but gradually under competing factors such as socio-economic characteristics of farmers, access to loan, land size, cosmopolitanism, access to extension services as well as farmer's knowledge level of the innovation, perception and attitude towards the innovation (Ayodele, Alfred & Akinmoyegun, 2016; Onyeneke *et al.,* 2019). However, while some researchers contend that psychological characteristics of farmers (knowledge, perception and attitude) are the main drivers of variation in adoption (Seline, Delia, Oluyede,Gudeta & Maarlen, 2015), others found knowledge, perception and attitude as the major factors that either inhibit or promote adoption of any innovation (Baksh, Ganpat & Narine, 2015). Based on this premise, it is very pertinent and necessary that this study ascertain the knowledge and attitude of the farmers towards the adoption of pro-vitamin A bio-fortified cassava in Anambra state, Nigeria. Specifically, the study sought to identify the respondents' sources of information on pro vitamin A bio-fortified cassava (PVABC); assess farmers' level of knowledge on the production practices of PVABC; ascertain the attitude of the respondents towards the adoption of PVABC; and determine perceived constraints to respondents' adoption of PVABC.

2. MATERIALS AND METHODS

2.1 *Study Area*

The study was carried out in Anambra State, in the South-eastern part of Nigeria. The State is between latitude 5º 38 and 6º 47 North and longitude 6º 36 and 7º 21 East of the equator. The capital of the State is Awka, and Onitsha is one of the major commercial cities. Its total land area is about 4,844km²(1,870sq metre) and it share boundaries with Delta State to the West, Imo State and Rivers State to the South, Enugu State to the East, and Kogi State to the North. The state comprises 21 Local Government Area (LGA's) and four agricultural zones (AZ's) namely; Aguata, Anambra, Awka and Onitsha. There are 6 blocks in Aguata AZ, 4 blocks in Anambra AZ, 5 blocks in Awka AZ and 6 blocks in Onitsha AZ (Obianefo, Nwigwe, Meludu, & Anyasie, 2020).The climate is typically equatorial with two main seasons, the dry and the rainy seasons. Anambra State experiences dry season from late October to early May and has at least six dry months in the year. The vegetation consists of rainforest, wooden savannah and grasslands.

2.2 ***Sampling procedure and method of data collection***

The population for the study comprised of all cassava farmers in Anambra State. Multistage, random and purposive sampling procedures were used in selecting the respondents. In the first stage, three local government areas namely; Ihiala, Anambra East and Orumba South local government areas were selected out of the 21 local government areas in the State where the PVABC stems have been distributed. In the second stage, two town communities were selected through random sampling technique from each of the selected local government area. Uli, Ihiala town, Nsugbe and Igbariam were selected in Ihiala and Anambra East respectively while Eziagu and Ezira towns were selected in Orumba South, thus giving a total of six town communities. In the third stage, two village communities were selected from each town community through simple random sampling technique hence giving a total of twelve village communities visited. In the fourth stage, eight cassava farmers who have knowledge of PVABC but have not planted in each village community were purposively selected. Thus, a total sample size for the study was ninety-six (96) farmers.

2.3 ***Measurement of variables and data analysis***

Data for this study was collected from the farmers through the use of structured interview schedule. Farmers' sources of information on PVABC technology were measured by providing a list of the various sources of agricultural information. The respondents were required to tick 'Yes' or 'No' against each option. They were also required to indicate preferred information sources which were later ranked. In order to determine the knowledge of farmers on PVABC production techniques and nutritional value, relevant knowledge questions were provided. They were divided into positive and negative knowledge statements of which each correct response scored 1, while an incorrect response scored 0. The total knowledge scores were thereafter computed for each respondent and later categorized into no knowledge=0, low knowledge=1-6, moderate knowledge=7-12 and high knowledge levels = above 13 correct score on knowledge questions. To ascertain the attitude of the respondents towards the adoption of PVABC**,** respondents were asked to indicate their responses to the attitude statements on a five-point Likert scale of strongly agree (4), agree (3), neutral (2), disagree (1) and strongly disagree (0). These figures were added and further divided by 5 to get a mean value of 2.0. To get mean value used for decision rule, 0.05 was added to 2.0 and also subtracted 2.0 to give 2.05 and 1.95 respectively. Thus, variables with mean greater than or equal to 2.05 were considered highly perceived attitude while mean scores less than 2.05 were considered otherwise. The level of agreement determining factors, the minimum (disagree scores) was considered as the lowest cut-off point, whereas the average (neutral scores) and maximum (agreed scores) were considered as the highest cut-off point. These were further categorized into negative and positive attitude by their correct responses on administered attitude statement. To ascertain perceived constraints to farmers' adoption of PVABC**,** farmers were asked to indicate their responses from a list of constraints that were provided. A five-point Likert scale of not at all (0), not serious (1), a little serious (2) serious (3) and very serious (4) were used to measure the constraints. The values were added together and divided by 5 to obtain a mean score of 2.0. Thus, variables with mean scores greater than or equal to 2.0 were regarded as serious constraints, whereas variables with mean scores less than 2.0 were regarded as unserious constraints to the adoption of PVABC.

Data generated from the interview were analyzed with IBM SPSS software using descriptive statistics such as percentage and mean score, as well as factor analysis.

3. RESULTS

3.1 Sources of information and its preference on PVABC

Table 1 reveals that respondents sourced information on PVABC through fellow farmers (55.2%), friend/neighbours (26.0%), Extension (19.8%), families (5.2%), fadama office (3.3%) while 1% of the respondents each specified radio, market and international agencies as their source of information on PVABC respectively. The result of the information preference also shows that fellow farmers with weighted index of 186 ranked first while friends and neighbours (96) ranked second. Extension (34) ranked third while families (24) ranked fourth. Fadama office (13) ranked fifth, international agencies (4) ranked sixth while radio and market with weighted index 2 respectively rank seventh.

Table 1: Sources of information and its preference on PVABC

Information Sources	Frequency	Percentage	Weighted index	Ranking
Extension agents	19	19.8	34	3rd
International agencies	1	1.0	4	6th
Fadama office	3	3.1	13	5th
Fellow farmers	53	55.2	186	1st

Friend/neighbours	25	26.0	96	2nd
Families	5	5.2	24	4th
Radio	1	1.0	2	7th
Market	1	1.0	2	7th

Field survey 2018

3.2 Knowledge level of respondents

Data in figure 1 shows that the majority (91.70%) of the respondents had high knowledge on PVABC production practices while 8.3% have moderate knowledge level on its production practices. This result shows that majority of cassava farmers in the study area are highly knowledgeable about PVABC even though they have not yet planted it. The milestone knowledge could be attributed to their level of experience in the production of other cultivars of cassava.

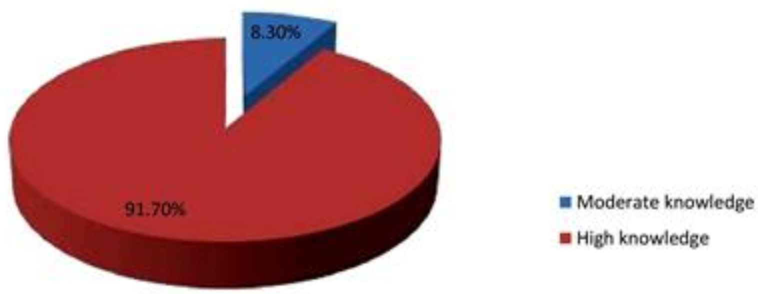

Figure 1: Knowledge level of respondents on PVABC

3.3 Attitude of respondents towards adoption PVABC

Data in table 2 revealed that the attitude of the respondents towards PVABC adoption include; Discouraged due to inputs unavailability ($\bar{x}$=3.95), its less fertilizer requirement ($\bar{x}$=3.50), better nutritious quality than the local variety ($\bar{x}$=3.33), preference for local variety to the improved variety ($\bar{x}$=2.95), more capital outlay requirement ($\bar{x}$=2.30) and more expensive than local variety ($\bar{x}$=2.14). These were marked by the respondent as their attitude towards adoption with mean scores higher than the average.

Table 2: Attitude towards the adoption of PVABC

Attitude questions	**Mean** ($\bar{x}$)	Std. Deviation
I prefer local variety to the improved variety	**2.95***	1.118
I can't handle the production technologies of PVABC.	0.24	0.915
It is usually for the rich farmers only	0.24	0.903
Improved technologies are only for the educated	0.31	1.059
They require regular contact with extension workers to fully learn and practice	1.31	1.808
Better quality than local variety	1.56	1.024
More expensive than local variety	**2.14***	0.734
They have good storage quality	1.70	1.067
They are not culturally suitable	0.23	0.814
They damage my environment	0.09	0.582
Better in taste than local variety	1.86	0.936
Discouraged due to inputs unavailability	**3.95***	0.366
I don't like the colour.	0.64	1.058
It will not be good for the type of food I will want to produce from the cassava.	0.54	1.015
They do not conform with land tenure system	0.04	0.248
Makes one feel socially relevant	0.89	1.213
No much difference between improved and local variety	1.41	0.969
They usually take more time to cook	1.97	0.308
It requires more capital outlay	**2.30***	1.087
It will increase pesticide usage	0.93	1.018

It is not safe for human consumption	0.10	0.533
It will increase pest resistance	0.32	0.789
I like it because it is more nutritious than the local variety	**3.33***	1.102
It will reduce the need for fertilizer usage	3.50*	1.036

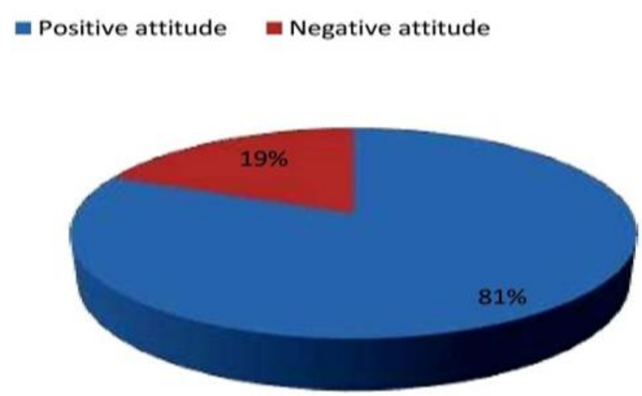

Figure 2: Farmers attitude level towards adoption of PVABC

3.4 Factor analysis of perceived constraints towards adoption of PVABC

Entries in table 3 shows that perceived constraints towards PVABC production were organised into four factors: Environmental constraint (factor1), cost and production constraints (factor 2), labour constraints (factor 3) and marketing constraint (factor 4). Specific factors that constitute environmental constraints were: unavailability of stem cuttings for planting (**-0.968**), PVABC production technologies don't tally with previous practices (**0.968**), socio-cultural restrictions (**0.968**) and theft (**0.660**). In the same way, the PVABC innovation just like any other innovations is hindered with extra costs to tackle its acceptance and utilization. The specific factors that constitute cost and production constraints were: high cost of insecticides and herbicides needed to protect crop **(-0.608**), problem of pest and diseases **(-0.561),** lack of capital for production **(0.510)** and lack of extension training to improve production skill (**0.571**).

In addition, unavailability of labour **(0.875**) and high cost of labour (**0.820**) were the component factors that constitute the labour constraints which affected adoption of PVABC. Furthermore, lack of demand for PVABC variety (**0.785**), colour barrier (**0.768**) and lack of ready market for sales of PVABC **(-0.584)** were the factors that loaded high under marketing constraints. Adequate and constant demand for product from innovation can helps to speed up acceptance of the innovation but the reverse is always the case.

Table 3: Factor analysis of perceived constraints towards PVABC adoption

Perceived constraints to adoption	**Components**			
	1	**2**	**3**	**4**
Low soil fertility	0.244	0.223	-0.074	0.156
Unavailability of stem cuttings for planting	**-0.968**	-0.008	-0.033	0.046
High cost of acquiring stem cuttings	0.064	0.368	-0.301	0.152
Distance to source of cuttings		-0.340	-0.043	-0.153
Lack of proper production skills	-0.053	0.029	0.371	0.124
Unavailability of labour	-0.068	0.222	**0.875**	-0.062
High cost of labour	-0.068	0.254	**0.820**	-0.115
High cost of insecticides and herbicides needed to protect crop	0.213	**-0.608**	-0.016	-0.072
Inadequate land to encourage large production that will compensate high cost	-0.149	-0.441	-0.196	-0.096

Problem of pest and diseases	0.024	**-0.561**	-0.178	0.021
Lack of capital for production	-0.260	**0.510**	-0.101	0.135
Lack of extension training to improve production skill	0.019	**0.571**	0.088	-0.106
Transportation constraint and inaccessible roads	0.170	-0.338	0.255	-0.343
Lack of ready market for sales of PVABC	0.254	**-0.584**	-0.222	-0.038
Consumers don't demand this variety	0.288	0.071	0.058	**0.785**
Consumers don't like the color	0.103	0.140	0.003	**0.768**
Unpleasant taste	-0.256	0.137	0.006	0.465
Close weeding intervals	-.024	0.350	-0.410	-0.283
Lack of storage facility	0.102	0.313	-0.075	-0.490
PVABC Production technologies don't tally with previous practices	**0.968**	0.008	0.033	-0.046
Socio-cultural restrictions	**0.968**	0.008	0.033	-0.046
Theft	**0.660**	-0.260	-0.137	0.071
Poor access to credit facilities	-0.317	0.058	0.164	-0.097

FIeld survey 2018

4. DISCUSSION

Fellow farmers were the most common and preferred source of information for farmers on PVABC innovation. This may be explained by the degree of relationship existing between farmers in the area. It may be that membership of social organization is prevalent and strong among the respondents which may likely enable them to share information about production practices of PVABC within themselves. Farmer to farmer interaction could be preferred because it does not require official protocol. This preference could be attributed to accessibility and mutual understanding among the respondents. Families/neighbours as well as extension agents also stand out in the dissemination of PVABC innovation. Family and neighbours interact with each other on daily basis and this may provide opportunities for sharing information on improvement of their farm production. The finding agrees Ojeleye (2018) who found that friends/other farmers, extension agents, posters/leaflets and radio were the major sources of information for cassava farmers. In addition, Chidiebere-Mark and Anyanwu (2020) affirmed that extension agents and farmers group were the major sources of information for farmers on PVABC other than radio, leaflet/newspaper and television. But, on the contrary, Idiake-Ochei and Omoregbee (2017) found that cassava farmers preferred television and radio more than friends/neighbour for their information on cassava production.

Farmers have high knowledge about PVABC innovation and this may be attributed to the fact that they have been cultivating other species of cassava for years prior to the introduction of PVABC which is some-what similar to their old cultural practices of cassava production. It could also be as a result of the acquisition of formal education by the respondents that avail them the opportunity to access more information on pro-vitamin A cassava. Similarly, it may be tied to their mutual interactions among fellow farmers, family/neighbour and perhaps extension agents on PVABC innovation. Adequate knowledge of innovation has been found to be important facilitator of innovation adoption. Farmers who have adequate knowledge of technology are more likely to adopt than their counterparts. The result is in consonance with Olayinka, Olatunji, Ololade, Oluwatosin, & Ayanda (2020) who found that farmers in Kwara State have high knowledge on pro-vitamin A bio-fortified cassava innovation.

Farmers' attitudes are important in determining adoption of improved technology. Attitudes are evaluative responses towards the technology, and are formed as farmers gain information about the technology. From the result, majority of farmers had positive attitude to PVABC innovation probably because of their high knowledge on nutritional value of PVABC or its other desirable qualities such as early bulking, disease resistance, high dry matter content, high drought tolerance and provision of high quality flour. Better still the positive attitude may be connected to respondents' stage of life. Younger farmers do have positive attitude towards innovation more than their older counterparts because they have more access to information about any innovation, thus making them more knowledgeable which have a concomitant effect on their attitude towards the innovation and finally result into increased adoption. Also, younger farmers are less risk averse than older farmers and can venture into risky enterprise that is highly promising where older farmers are less willing to venture into due to their seldom admission to change their former practices. This supports Onunka, Ume, Ekwe, & Silo (2017) who found that farmers in Abia State had moderate but positive attitude to adoption of pro-vitamin A bio-fortified cassava. Surprisingly, farmers still prefer their local variety despite their favourable/positive attitude towards PVABC innovation. This may likely be connected to fear of taking risk. They may have seen accepting PVABC innovation as risk compared to the varieties they have been growing for years. This erroneous mind set/belief about the bio-fortified cultivar undoubtedly may limit the possibility of its adoption.

Environmental constraints are serious threat to PVABC innovation. The scarcity/unavailability of PVABC planting materials has been identified as a major constraint that limits the adoption of the technology in the area. It is so serious that farmers, in most cases travel wide (International Institute of Tropical Agriculture Ibadan, National Root Crops Research Institute Umudike) just to get PVABC stem cuttings. This finding is contrary to Onyeneke *et al.*, (2020) who asserted that scarcity of PVABC stems is not a serious constrain to cassava bio-fortified technology adoption. In a similar way, socio-cultural norms place threat to many innovations by restricting access to information about the innovation and in extreme cases, forbid members of the society from adopting the technology. Surprisingly, farmers identified incompatibility between the PVABC innovation and the previous farming practices as their constraint. Any innovation that did not align with the precious farming practices of the target audience might receive negative attitude and the degree of its adoption lowered. The result is consistent with Silva and Broekel (2016) who found that a lack of resources, incompatibility and complexity of new technology, socio-economic and cultural constraints were the constraints for adoption of newly agricultural technology programmes.

In the same way, the cost and production problems were identified to have hindered adoption of pro-vitamin A cassava. Most production inputs such as herbicides and pesticides were expensive despite lack of capital for the production. This is in addition to poor training of the respondents on the use of the innovation. The study is consistent with the findings of Olaosebikan *et al.,* (2019) which states that high cost of inputs is a serious constrain to bio-fortified cassava production. In addition, Uwandu, Amadi and Igwe (2019), and Onyeneke *et al.,* (2020) confirmed that high cost of cassava stems is responsible for lack adoption of bio-fortified pro-vitamin-A cassava varieties.

Also, labour constraints as well as marketing constraints were identified to have hindered adoption of PVABC innovation. Lack/high cost of labour is a serious threat to adoption of PVABC innovation especially when farmers hae no enough income or large family to carry out the labour. Large household size in most cases provides enough labour for their house head on farm. The result is consistent with the findings of Onyemma, Tertsea, Ogbonna, & Nwafor (2019), and Amadi, Onwusiribe and Uchechukwu (2020) which states that inadequate fund, high cost of labour, lack of farm credit among others constitute constraints to adoption of pro-vitamin A bio-fortified cassava.

Furthermore, lack of market or demand for the produce threatens the adoption of PVABC innovation in the area. Access to market is crucial for consideration before adoption of innovation. Adoption of an innovation is fast when there is available market as well as demand for the product. Pro-vitamin A bio-fortified cassava being a new entrant has not received wide demand from people irrespective of its numerous benefits. Corroborating the finding, Onunka *et al.,* (2017) and Onyemma *et al.,* (2019) asserted that there is lack/poor accessibility of market for improved cassava varieties/PVABC varieties. Also, Amadi *et al.* (2020) confirmed in their findings that adoption of pro-vitamin A bio-fortified cassava is constrained by lack of market for the product.

5. CONCLUSION AND RECOMMENDATIONS

Farmers have high knowledge and positive attitude on pro-vitamin A bio-fortified cassava (PVABC) innovation adoption. However, adoption of the new variety of cassava was hindered by constraints related to environment, cost and production, labour and market. Given the above, the study recommends that government and non-governmental agencies should look into these constraints especially provision of financial support to research institutes to multiply pro-vitamin A bio-fortified cassava planting materials and distribute them across to the farmers within the country so as to produce enough for consumption. Government should also provide enabling opportunities to extension workers that will be helpful to them in exercising their expertise in the face of training of farmers and disseminating of information on a particular innovation to farmers and taking the feedback to innovation developers. In addition, government should provide farmers with necessary production inputs and ready markets so that they could easily embrace innovations.

Conflict of interest
The authors declare that they have no conflict of interest.

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Ethical approval
This article does not contain any studies with human participants performed by any of the authors.

Data and materials availability
All data associated with this study are present in the paper.

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