Assessment of Barriers and Promoters for the Adoption of Orange-fleshed Sweet Potato in Kano State, Nigeria

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ABSTRACT

Background and Objectives: Vitamin A deficiency (VAD) slows recovery from illnesses and increases the severity of infections like measles and diarrhoeal disease. Vitamin A deficiency affects about 30% of children less than 5 years of age in Nigeria. The use of β-carotene biofortified Orange-fleshed sweet potato (OFSP) has been recognised as one of the effective, food-based, and nutrition-sensitive agricultural approaches to improve vitamin A intakes. However, the adoption of this biofortified crop merits further study. This research assessed knowledge, attitude and adoption of OFSP among farmers in Kano State.

Methods: Data were collected using questionnaire and focus group discussions (FGDs) from 125 respondents from farmers and consumers, in-depth interview was done with stakeholders in ministry of Health and Agriculture, eHealth and CIP, these were selected through purposive and simple random sampling. Mean, frequencies and percentages of data collected were analysed using SPSS (version 22).

Results: The questionnaire result shows that OFSP acceptance was <30%, Choice preference showed that majority of farmers and consumers valued the WFSP more than the OFSP. The FGD's result indicates that the factors for promotion of adoption of OFSP include; availability of market niche, affordability, access to OFSP vines, pleasant taste and texture, sensitization on OFSP benefits, resistance to pest, improve shelf life and promotion of local vines production system while barriers are the counteracts of the above mentioned.

Conclusion: The level of adoption of OFSP in Kano State appeared low (<30%) among the respondents. This calls for efforts in addressing the barriers for the adoption of OFSP.

KEYWORDS:

- Vitamin A deficiency,
- Biofortification,
- Adoption,
- OFSP
- Farmers

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INTRODUCTION

Malnutrition is still a serious global public health challenge, especially in South Asia and Sub-Sahara Africa (1). One in three individuals suffers from micronutrient malnutrition, also known as hidden

hunger, with the most common deficiencies being vitamin A, iron, iodine, and zinc (2). The majority of the world's hidden hunger cases occur in developing countries where access to a diverse diet is limited. Instead, diets in developing countries are often characterized by a high intake of staple food (3). According to the World Health Organization (4), 45 countries have vitamin A deficiency of public health significance, which includes overt signs of deficiency, and 122 countries have subclinical levels of vitamin A depletion with marginal liver reserves. In Nigeria it has been estimated that 25% of children less than six years of age suffer from vitamin A deficiency (5 and 6). Also, it was reported that about 30 per cent of under-five children and 20 per cent of pregnant women in Nigeria are vitamin A deficient (7).

Micronutrient deficiencies contribute significantly to child mortality worldwide, and annual vitamin A and zinc deficiencies are estimated at 600,000 and 400,000 deaths respectively (8). Deficiency of vitamin A by itself causes 964,000 Disability Adjusted Life Years (DALYs) in Nigeria (9). Surveys in Nigeria showed that vitamin A dietary intake was inadequate in 83% of pre-school aged Nigerian children (10). National surveys show that Kano state has one of the lowest vitamin A, uptake levels (11). However, several methods have been adopted to address vitamin A deficiency in Nigeria. They include nutrient supplementation (pharmaceutical), home food fortification and condiments-fortification of staple foods and biofortification (12).

Vitamin A has a role in many functions including growth, vision, epithelial differentiation, immune function and reproduction (13). The storage form is retinol esterified to fatty acids e.g. palmitic and oleic acids. Retinal is involved in vision and retinoic acid is involved in growth and cellular functions (14). Consumption of provitamin A orange-fleshed sweet potato (OFSP) reduced the prevalence and duration of diarrhoea episodes and Provitamin A-biofortified maize significantly improved pupillary responsiveness (15,16). Through daily consumption of biofortified foods, 25% to 100% of the Estimated Average Requirements (EAR) of vitamin A, iron, or zinc can be met for young children (1-6 years) old and non-pregnant, non-lactating women of reproductive age (WRA; 15-49 years old) (17). Therefore, modified crops possibly may offer food-based interventions if fully adopted and accepted, and could reach the remote populations with micronutrients deficiency (18).

Therefore, the need to assess the barriers and promoters of adoption of OFSP in Kano is one of the cities with high population of poor and vulnerable people, as such this research is set to assess the adoption of OFSP by farmers in some Kano communities where intervention programs by eHealth Africa project in 2015 and that of international centre for potatoes (CIP) project on Development and delivery of biofortified crops at scale (2019-2022) have been carried out.

Materials and Methods

The population of the study comprised of farmers who completely or occasionally cultivated the various sweet potato varieties either as a major or minor crop. Purposive sampling procedures were used in selecting the locations for the study. Five local governments were selected i.e., Rimin Gado, Tofa, Garko, Bichi, and Dawakin Kudu LGAs among these only communities that Orange fleshed sweet potato (OFSP) dissemination programs was conducted were selected, these are Gulu, Doka, Kafin Malamai, Bichi and Sarai respectively. Farmers' that participate in the flag off of the crops and those that later adopt the crop cultivation were selected with the aid of Kano Agriculture and rural development agency (KNARDA) agent in each community. A total of 125 farmers were selected purposively out of which 25 were adopters and 100 were non-adopters. Recruitment and sensitization processes were carried out, in which farmers were informed on the research activities, importance of the research, why the need to cultivate OFSP. Farmers involved in this research signed the form of inform consent either written or verbatim before commencement of the research.

This study was conducted within four months (August to November) of 2021. Qualitative and quantitative data collection processes were used in generating responses from the respondents through the use of participatory tools. Qualitative data for the study was collected through Focus group discussions (FGDs) with farmers (Both adopters and Non-Adopters) and in-depth interview with key stakeholders. Quantitative data for the study was collected from the study population through the use of a questionnaire (structured interview). Farmers'

sources of information on OFSP 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 their preferred source of information on OFSP. This was eventually ranked in their order of preference. In order to determine the knowledge of farmers on OFSP, relevant knowledge statements were drawn. To eliminate guessing by the respondent, the statements were divided into positive and negative statements. A total of 30 questions items were employed and the respondents were asked to tick 'Yes' to each correct statement and 'No' to an incorrect statement or choose from options provided. Each 'Yes' answer was represented as 1, 'No' answer was represented as 2, options in alphabets were awarded numerical values with corresponding figures. The summation of scores were converted to percentages. Data for the study were analysed using frequency, percentage and mean scores. The statistical package for service solution (SPSS) version 22 was

Table 1: Socio-demographic characteristics

Variables	Adopters	Non-Adopters
Category of participants Farmers		
Gender		
Male	88	96
Female	12	4
Total (%)	100	100
Age		
<40	36	53
41-60	60	45
>60	16	2
Mean (Age)	54.33	47.37
Education		
No school	16	48
Elementary	20	30
Secondary school	24	15
Higher education	40	7
Total (%)	100	100
House hold size		
<10	64	55
11-20	28	37
21-30	8	5
>31	0	3
Total (%)	100	100
Source of income		
Farming only	56	83
Business / Farming	28	17
Civil servant/ Farming	16	0
Pension/ Farming	0	0
Distance to market(km)		
0-10km	100	100
11-20	0	0
21-30	0	0
31-40	0	0

used in the data analysis.

Ethical approval for the research was obtained from National health research ethics committee Kano state Ministry of Health with the reference number, NHREC Approval number: NHREC/17/03/2018

4.1 RESULTS

4.1.1. Socio-demographic characteristics of the study participants

The results in Table 1 summarises the demographic characteristics of the study respondents who were farmers and consumers. Adopters in the research are those who have cultivated OFSP doe a minimum of one year, while the non-adopters are those that have never grown OFSP. The higher number of adopters (88.0 %) and non-adopters (96.0 %) were males (Table 1). The average age of adopters and non-adopters of OFSP was about 37 and 33 years, respectively. The average years spent by the adopters in formal education was about 16.8 years, while the non-adopters spent an average of about 10.4 years. The majority of household size for both adopters and non-adopters are having higher number of children less than 10 years (64%) and (55%) respectively, but have lower percentage of children within the age range of 11-20 (28%) and (37%) for adopters and non- adopters respectively, it was found that majority of the adopters (56%) and non-adopters (83%) depend solely on farming as a source of income. All adopters were found to cultivate OFSP alongside other varieties of sweet potato. However, all civil servants whom were farmers (16%) were adopters.

4.1.2. Health- seeking behaviour

Table 2 represent health seeking behaviour, shows that majority of the adopters (72.0%) and non-adopters (65.0%) had children that were within 0-10years, cases of Night blindness (8%) and (5%), poor growth having (20%) and (2.0%), subsequent illness (16.0%) and (20%) diarrhoea and measles (8.0%) and (6.0%) were witnessed for adopters and non-adopters respectively. Majority of the adopters (60%) and non- adopters (89%) attended government clinic or hospital, few attend traditional (36.0%) and (10.0%), and private clinics (4.0%) and (1.0%) for adopters and non-adopters respectively.

4.1.3 Food frequency

In Table 3 gives the result for food frequency, the consumption of food varieties rich in vitamin A, was based on personal interest and means of buying. All adopters and non-adopters were found to consume carrots, vegetables, yellow maize, fish, milk and other dairy products. But variation in level of consumption occurred in O FSP (100.0%) and

Table 2: Health-seeking behaviour

Children under 5	Adopters (%)	Non- Adopters (%)
1-10years	72	65
>10years	28	35
Health facility attended		
Private clinic	4	1
Government clinic or hospital	60	89
Traditional	36	10
Vitamin A def. symptoms witnessed in their children.		
Night blindness	8	5
Poor growth	20	2
Subsequent illness	16	20
Diarrhoea	8	6
Measles	8	6
None	40	61

Table 3: Food consumption frequency of food varieties rich in vitamin A

Vit A rich foods	Adopters (%)	Non-adopters (%)
Carrot		
Yes	100	100
No	0	0
OFSP		
Yes	100	26
No	0	74
Vegetables		
Yes	100	100
No	0	
Fish, meat, dairy products		
Yes	100	100
No	0	
Yellow maize		
Yes	100	100
No		
Red sweet potato		
Yes	76	13
No	24	87
Frequency of daily normal food consumption by respondents		
Thrice per day	76	88
Twice per day	24	10
Once a day	0	2

Table 4: Knowledge and awareness of biofortified foods

Awareness of biofortified foods	Adopters (%)	Non-Adopters (%)
Pro vitamin A maize	100	87
Orange-Fleshed sweet potato (OFSP)	100	92
Vitamin A cassava	4	0
High iron pearl millet	4	0
Medium of awareness about OFSP		
Newspapers and magazines	0	0
Radio/ T.V	24	15
Health workers	24	1
Family, friends, neighbours and colleagues	4	1
Religious leaders	4	0
Agric extension workers	44	73
Level of importance of OFSP		
Very importance	100	91
Somewhat important	0	7
Not very importance	0	2
Possibility of problem in consuming OFSP		
Yes, very possible	0	0
Yes, possible	0	5
Maybe	8	20
No, at all	92	75

(26.0%) and Red sweet potato (76.0%) and (13.0%) for adopters and non-adopters respectively.

4.1.4 Knowledge and awareness of biofortified foods

Table 4 shows the percentage of correct answers of the knowledge and awareness of the existence of OFSP by the adopters and non-adopters. Both adopters (100.0 %) and non-adopters (87.0 %) each were highly knowledgeable over the existence and method of propagation of OFSP using vine cuttings from older plants. On the other hand, the respondents had also knowledge about other biofortified crops such as Provitamin A maize (100.0 %) and non-adopters (92.0 %), whereas only few from the adopters knew about Vitamin A cassava (4%) and High iron pearl millet (4%). Both adopters (44.0 %) and non-adopters (73.0 %) mainly knew about information on OFSP from extension agents, while other adopters (24%) knew about OFSP from Radio/television and health workers, with few (4%) from family and friends and religious leaders. Majority (>75%) of adopters and non-adopters believed that biofortified foods are of much importance and could not lead to any harm after receiving the sensitization on the importance of biofortified OFSP and other biofortified products. However, only few (<20) think of possibility of problem in consuming OFSP.

Table 5: Willingness to buy, consume and grow bio-fortified foods

Willingness to buy and consume OFSP	Adopters (%)	Non-adopters (%)
Yes	100	86
No	0	7
Maybe	0	7
Preferred variety of sweet potato		
White:		
Yes	100	100
No	0	0
Yellow:		
Yes	28	16
No	72	84
Orange		
Yes	100	22
No	0	78
Will you grow OFSP		
No	0	31
Yes	100	60
Maybe	0	9

Table 6: Preferred sources of vines

Ways of having access to vines	Adopters (%)	Non-Adopters (%)
Market places	32	21
Agricultural extension worker	52	62
Local govt agric dept	8	15
State govt agric dept	8	2
Govt agric dept; Government agriculture department		

4.1.5 Willingness to buy, consume and grow OFSP

In Table 5, majority of adopters (100%) and non-adopters (86%) were willing to buy and consume OFSP. On the contrary preferences of the white sweet potatoes are 100% and 100%, yellow sweet potatoes are 28% and 16%, and orange sweet potatoes are 100% and 22% for adopters and non-adopters respectively. this shows that majority of the non-adopters showed lower acceptance (<22%) level of OFSP. Moreover, only (60%) of the non-adopters are willing to grow OFSP, (31%) are not willing to grow and (9%) might grow OFSP.

4.1.6 Preferred sources of vines

Table 6 indicates that adopters most preferred source of vines is through agricultural extension workers (52%) followed by Market places (32%). Non-adopters that are willing to cultivate OFSP preferred source of vines are agricultural extension workers (62%) followed by Market places (21%). With few (<15%) chosen local and state government agricultural departments

4.1.7 FGDs and Consultation

4.1.7.1 Summary of factors for promotion of adoption of OFSP

Table 7 shows that the motivational factors that increased the adoption of OFSP by the farmers were; availability of market for the sale of OFSP product, affordability, availability and access to OFSP vines, high yield of OFSP, high yield of OFSP, local vines production system and resistance to pest Are the major factors that will promote adoption by the farmers

4.1.1.8: Summary constraints to the adoption of OFSP among non-adopters.

Table 8 shows the constraints that hinders the adoption of OFSP by non-adopters. The major constraints included: lack of market to sell OFSP produce, high cost, availability and accessibility of OFSP vines needed for planting, unpleasant taste and texture of cooked OFSP, loss of resistance to pest by OFSP and high cost of OFSP root, while lack of capital to cultivate OFSP, lack of knowledge of health benefits of OFSP and high cost of inorganic fertilizer

Table 7: Summary of factors for promotion of adoption of OFSP

Sn	Variables
1	Availability of market for the sale of OFSP product
2	Affordability, Availability and Access to OFSP vines
3	Moderate price of inorganic fertilizer, herbicides and Planting materials
4	Pleasant taste and improve texture
5	Increase awareness and sensitization on the importance of OFSP
6	Moderate price of inorganic fertilizer, herbicides and Planting materials
7	Resistance to pest
8	Improve shelf life
9	Local vines production system

Table 8: Summary of reported constraints to the adoption of OFSP among non-adopters.

Sn	Variables
1	Lack of market to sell OFSP produce
2	High cost, availability and accessibility of OFSP vines needed for planting
3	Unpleasant taste and texture of cooked OFSP
4	Lack of capital to cultivate OFSP
5	High cost of OFSP root
6	Lack of knowledge of health benefits of OFSP
7	High cost of inorganic fertilizer and herbicide
8	Loss of resistance to pest by OFSP

and herbicide are averagely considered as constraints by the farmers.

DISCUSSION

The adopters of OFSP are majorly males with average ages around 47.37-54.33years, which is an active age of energy and acceptance of new technology unlike the old age farmers which were already used to local varieties due to long term experience. Few females were observed due to the fact that, in the north females hardly possess farms and/or have lack of decision-making power in the nature of crops to be produced by their husbands and other socio-cultural values. Education appears to influence adoption of OFSP significantly, since it's a factor that allows one to understand, comprehend vital information and accept scientific innovations (19). Households having children lower than 10years of age were majorly the adopters. This might be due to the informed knowledge during the trail on the health benefits of OFSP to children. Again, majority of the adopters rely on farming as a major source of income. Most of the adopters were found to cultivate the OFSP in lower amount for family use due to poor market niche of the improved product. However, all the civil servants who are farmers adopted the production of OFSP. In contrast, non-adopters who were majorly farmers preferred to grow other local varieties. The probable reason for non-adoption of OFSP by non-adopters may be explained by inadequate marketability and acceptance by consumers. There were number of cases of symptoms vitamin A deficiency noted during the study such as night blindness, poor growth. among children in the communities might be due to consumption of food with low vitamin A content. Although, Adopters were averagely found to have children with few cases which is an indication of good nutrition. Majority of the adopters are aware of the existence of biofortified foods, their nutritional importance through extension agents and other communication channels. Non- adopters also, were aware of the existence of biofortified food but lack knowledge of the nutritional importance and health benefits, they were more concerned with the yield, marketability, shelf life and resistance. In terms of consumption, majority of non-adopters were willing to buy and consume. The fact that dopters still cultivated the OFSP varieties as mentioned by the respondents of FGDs showed that their continuous interest may be due to perceived benefits of cultivating OFSP. It was reported also by the respondents in the FGDs that not up to 5% of the total area under production of sweet potato is used

to cultivate OFSP in the communities. Majority of the farmers preferred to cultivate the white variety of sweet potato due to its marketability, taste, texture, quality even though the OFSP has larger roots (which is a significant value in making profit). Choice preference showed that majority of farmers and consumers valued the WFSP more than the OFSP and the YFSP. This finding is consistent with consumer preferences studies carried out by Naico and Lusk (20) and Chowdhury et al. (21). Moreover, another major factor that affected the area put under OFSP cultivation, is the number of households engaged in its production were shortage of planting materials and drought stress which were in line with the findings delivery of OFSP in Tanzania (22). The varieties of OFSP mainly cultivated by the farmers were King J., Mother Delight and Solo Gold. The adopters generally noted that row OFSP had a sweeter taste, was fast maturing and showed higher yields than other sweet potato varieties. Fast-maturing variety makes it possible for farmers to grow and cultivate within three to four months, this increases profit. In congruence to this, Foster and Rosenzweig highlighted that a key determinant of the adoption of a new technology is the net gain to the farmer from adoption (23). Among all the OFSP varieties, Mothers delight was majorly cultivated by all the adopters. The reason, according to the respondents, is that Mothers delight is resistance to pest, increase size, taste and marketability compared to other OFSP varieties. It has been noted that characteristics of a technology may either encourage or hinder its adoption (24). The adopters indicated that extension contacts have been low, which results in delayed supply of vines which causes hindrance in the production quantity yearly. The non-adopters of OFSP complained that the costs of OFSP vines and complications in carrying out production discouraged adoption. Similarly, Cha et al. (25) reported that complexity of carrying out the recommended production practices of OFSP as well as difficulty in integrating OFSP into their existing production system were major barriers hindering their adoption of OFSP (25). Many respondents complained about the cost of vines and efficient delivery of vines. This may be the reason of low level of adoption by some farmers. Usually, OFSP vine are sold in bundles of 100 pieces, a bundle of OFSP is sold at NGN 300 and several bundles were needed to cultivate a plot. On the other hand, the farmers reported that they buy white fleshed sweet potato vines at a cheaper rate. Orange-flesh sweet potato vines and roots have also been reported to be more expensive than other sweet potato varieties in Zambia and Mozambique (25, 26 and 27).

CONCLUSION

The promoters of adoption of OFSP were nutritional and health benefits of OFSP, aroma and pleasant taste of OFSP. The non-adopters found it difficult to produce OFSP due to challenges involving marketability, cost, affordability and accessibility of vines, taste and texture, high cost of OFSP vines and roots, lack of investment by government and private companies.

RECOMMENDATIONS

1. Nutritional education should be incorporated into village gatherings, religious gatherings, schools, markets and hospitals to collectively sensitise people on the effects of malnutrition and the benefits of OFSP consumption in reducing the menace of vitamin A deficiency
2. Improvement of texture, amelioration of the intense orange colour, drought resistance of OFSP
3. Increasing access to vines by provision of vines producing points at local governments especially to irrigation farmers
4. Government should include OFSP in school feeding programs

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Conceptualization and Methodology: SID & SMA, Data curation & analysis: SID, Investigation & original writing: SMA, BIC, Writing, review & editing: SID, SMA, BIC, AO, VA & AJO, Supervision: SMA & BIC