Adoption of Improved Soyabean Technologies in Processing and Utilization as Supplement with Local Foods in Bauchi Local Government Area, Bauchi State, Nigeria

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Original Research Article

ABSTRACT

The study was carried out to determine the level of adoption of improved soyabean (*Glycine Max* (L) *Merril*) processing and utilization technologies as supplement with local food in Bauchi Local Government Area (LGA), Bauchi State, Nigeria. Bauchi LGA was purposively selected because there were many soyabean farmers in the area. Random sampling technique was used to select three villages from Bauchi LGA. Random cluster technique was used to select 15 farmers from each village totaling 45 farmers as sample size. Interview schedule was used to source relevant information from soyabean farmers on their socio-economic characteristics and level of adoption of the technologies. Twenty soyabean improved technologies were selected for supplementation with local foods, to assess the level of adoption of these technologies. The result revealed that both old and young, ranging from 20 to 70 years were involved in soyabean utilization and processing. The result also revealed that majority of the soyabean farmers were small-scale farmers ranging from

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0.1 to 4 hectares (ha) and family size ranging from 1 to 21 members. The respondents had many years of processing experience (1-15years) but were using local methods which may not eliminate the anti-nutritional factors in soyabean. Majority of the farmers were illiterate having only Quranic education (58%), 33% had formal education at different levels while, 9% had no formal education. The regression analysis revealed that out of nine socio- economic characteristics used as predictors, only household size and labour were positively significant ($P<0.001$) and processing was negatively significant ($P<0.05$) while, other six were not significant. These technologies were poorly adopted. Three of them were fairly adopted namely soya "*awara*" (cheese) (73%), soya *daddawa* (36%) and soya *kunu* (36%). Ten innovations were poorly adopted while, 7 innovations had zero adoption. The poor adoption of these soyabean improved technologies may probably be mainly due to lack of adequate education and inadequate extension services. To increase the adoption of these technologies, extension workers need to reach out to people by creating awareness through mass media and practical demonstration of processing methods. This is necessary because soyabean is good for the poor and the rich, also to both old and the young for good health and vitality.

1. NTRODUCTION

In Nigeria, soyabean *(Glycine Max (L) Merril)* was formerly used for animal feeds only to enhance the growth of the animals. It was not acceptable for human consumption because of some factors such as the problem of anti-nutritional factors and beany flavour. At Cornell University and the University of Illinois around late 1960s the workers there showed that heating could be used to reduce the action of lipoxygenase limiting the development of "off-flavours" produced in soya slurries [1]. Later researches conducted revealed that soaking and cooking can reduce the anti-nutritional factors in soyabean [2-4]. In Nigeria, commercial and home processing of soyabean for human consumption has increased in recent years, because of its health benefit and low cost of purchase. Soyabean can be used as supplement for many Nigerian foods to improve the protein content of human diets. Soyabean ranks as one of the richest source of protein especially when used in combination with cereals to compensate for its sulphur amino-acids deficiencies [5]. Soyabean is known to be free of cholesterol, has anti-cancer properties and its very rich in essential elements such as calcium, iron, zinc, phosphorus and various vitamins including vitamin A, B_6, thiamine, ribolaflavin and niacin (Table 1) [6].

Edible soyabeans proteins are rarely consumed directly, but rather they are used as ingredient in foods. These foods receive additional heat treatment either during processing or cooking before consumption [7].

A key problem associated with soyabean is that it contains some anti-nutritional factors, which inhibit the availability of the desirable elements such as proteins and minerals endowed in the grain [7,8]. According to [9], cooking improves texture and palatability quality of soyabean. Certain treatment such as cooking, baking, roasting and other common means of food preparation are effective in eliminating the anti-nutritional factors of raw soyabeans. However, whole soyabean have a good balance of the essential amino-acids and are an excellent dietary source of calories, minerals and vitamins. Eating soyabean products that are processed using the right methods (improved technologies) will reduce malnutrition in children [10] and promote good health in adults. Improved processing methods involved certain definite steps or pattern in order to obtain desired products suitable for human consumption. The objectionable flavour development has always discouraged soyabean use as human food in Nigeria. Europe and North America and other countries can tolerate this [8,11]. The processing is done to avoid problems of toxicity such as goitrogen associated with goiter formation [3,7]. The innovative methods of processing include soaking overnight (about 18-24 hours) [3,7], the soaking time may vary depending on the products to be produced. It is necessary for extension service to create awareness on importance of adopting improved soyabean processing technologies for human consumption and health benefit. Therefore, the main objective of this study is to assess the level of adoption of improved soyabean technologies in processing and utilization for human diet in the study area. Specific objectives are:

- To determine the socio-economic characteristics of the respondents on adoption of improved technologies in soyabean processing and utilization.

- To identify problems hindering the adoption of improved soyabean technologies.
- To create awareness through extension services about the usefulness of soyabean in human diets by supplementation with local foods.

Table 1. Nutritional composition of soyabean (per 100g)

Nutrient	Value
Protein (%)	40
Carbohydrates (%)	30
Fat (%)	20
Water (%)	10
Calcium	226mg
Phosphorus	554mg
Iron	8.4mg
Vitamin A	80iu
Vitamin B_1	1.1mg
Vitamin B_2	0.3mg
Niacin	2.2mg
Energy (cabries)	392

Osho et al. cited by [6]

2. MATERIALS AND METHODS

An investigation was carried out to assess the utilization of soyabean technologies as supplement with local foods in Bauchi Local Government Area (LGA) of Bauchi State, North eastern zone of Nigerian. The LGA falls within Nothern Guinea Savanah Vegetation Zone [12].

Bauchi LGA lies within the Western Agricultural Zone of Bauchi State. The western zone lies between 9º30' to 10º48'N and 8º 45' to 10º 15'E [13]. The study area has a tropical climate with long dry season period of seven months, ranging from October to April and a short wet season period of five months ranging from May to September. The diurnal temperature varies from an average daily minimum of 13.1ºC and maximum of 31.6ºC in January, while the relative humidity in August is 94% at 07.00. The LGA is made up of about 26 towns and villages which is the population for the study. There are no separate population figures for the towns and villages in the study area. The area has tropical soils of alluvial and colluvial origin. They are well drained and coarse textured with texture tending to the heavier sandy clay loams and clay loams for gravelly sandy loams [14]. Major crops grown include: sorghum, rice, groundnut, cowpea, millet, maize and soyabean. Also some vegetables and fruits are grown such as okro, *moringa*, water melon, pumpkin and carrots.

2.1 Sampling Technique

Bauchi LGA was purposively selected for this study because majority of the farmers there produce and process soyabean as food for human consumption. A simple random sampling technique was used to select three villages from the LGA. These included: *Bayara*, *Miri* and *Turum*. Random cluster sampling technique was used to select 15 soyabean farmers from each village. Pilot survey was carried out in order to have an insight into the question that was really necessary for the study and as part of training programme for the enumerators. This was done under close supervision. Forty five farmers were used for the study.

2.2 Data Collection

Data were collected through the use of interview schedule using trained enumerators. The interview schedule were designed to collect information relating to socio- economic characteristics of the respondents. These include: age, education level, household size, farm size (ha), processing experience, information sources and adoption of improved soyabean processing and utilization, social participation, labour source and awareness. Twenty soyabean improved technologies were selected for the study in relation to the local food of the people. These were: soya cheese (*awara*), soya *daddawa*, soya *kunu,* soya *yoghur*t, soya pap, soya vegetable soup, soya baby food, soya *chin-chin*, soya *kosssai*, soya bread, soya *tuwo*, soya *amala,* soya *moinmoin*, soya *danwake*, soya cake*,* soya *gari*, soya puff-puff and soya pancake. Hypothesis formulated stated that there is no significant relationship between socio- economic characteristics of the respondents and soyabean improved technologies adoption.

2.3 Data Analysis

The survey was carried out from 2002 to 2006. Data collected were analyzed using descriptive statistics (including frequencies, percentages and mean) to explain and show the extent of adoption of some selected soyabean technologies. Multiple regression analysis was also used to measure the influence of some socio- economic characteristics of respondents on adoption of soyabean technologies in processing and utilization (dependent variable) and the selected socio-economic characteristics were used as independent variables. In this study multiple regression analysis was used because there

were more than one independent variable explaining the behaviour of the dependent variable.

3. RESULTS

Socio- Economic Characteristics of the Respondents

A total of 45 selected farmers, were interviewed from the study area. The respondents ages were ranging from 20 to70 years. Household size ranged from 1 to 21 people and farm sizes ranged from 0.1 - 4 hectres (ha). Majority of the farmers here were small-scale farmers. The processing experience ranged from 1 -15 years. This revealed that some of the farmers were aware of the usefulness of soyabean in human diet (Table 2a).

The educational status of the respondents in Bauchi LGA showed that majority have only Quranic education (58%), 22% had formal primary education, 4% had secondary, only 7% had tertiary education , while 9% had no formal education (Table 2b).

Table 3, shows the regression analysis result on the influence of socio-economic characteristics of respondents on adoption of 20 soyabean technologies in processing and utilization. The result revealed that household size, labour and processing experience were significant (P<0.001), (P<0.001) and (P<0.05) respectively, while six predictors were not significant (Table 3). Hence, the hypothesis that stated that there is no significant influence of socio- economic characteristics of farmers on adoption of improved soyabean technologies was rejected.

Table 4 shows level of adoption of the 20 selected soyabean technologies in the study area. Soya cheese had the highest of 73% adoption, soya *daddawa* and soya *kunu* had 36% adoption each, soya vegetable soup had 24% of adoption and 7 other innovations had zero adoption (these include soya yoghurt, soya feed, soya *kossai*, soya bread, soya *amala,* soya puff-puff and soya pancake).

Table 5 depicts percentage distribution of constraints or problems hindering the adoption of some soyabean improved technologies in processing and utilization. Inadequate market had the highest constraint (20%), lack of awareness had 11% while, inadequate equipment had 11% and no response had 20%.

4. DISCUSSION

The use of soyabean as supplement with local foods and level of adoption of improve soyabean technologies in processing and utilization was investigated. Twenty selected soyabean processing and utilization were used for the study in Bauchi LGA of Bauchi State, Nigeria. The selection of foods for supplementation was done according to the local meal preparation and diet. Some of these foods were common to the study area and others were common to different communities in Nigeria. Soyabean was added to kunu (a common local drink) to become soya *kunu* so also were other foods and drinks. This was done to improve the protein content of the foods and drinks in the study area to solve the problem of malnutrition. In Africa, serious mal-nutritional problems is especially acute in terms of protein deficiency [15]. Also prices of livestock products such as meat, milk and eggs have risen beyond the reach of the poor. Soyabeans are good sources of nutrients as they contain about 40% high quality protein, 20% oil as well as minerals and vitamins [15]. The fat in soyabean is the unsaturated type [16]. Soyabean contains 43grams(g) of protein per 100g, which is the highest among the pulses. In Nigeria very limited information is available on adoption of processing and utilization of soyabean foods; also on factors influence their adoption.

4.1 Socio-Economic Characteristics of Respondents on Adoption of Soyabean Technologies in the Study Area

In the study area men and women were involved in the utilization of soyabean, women are mostly involved in the processing. The descriptive analysis (Table 2) shows that the age of the respondents ranged between 20 to 70 years which revealed that both young and old were involved in the soyabean utilization. The household size ranged from 1 to 21 members. Probably people with large family members prefer to use soyabean to replace meat and fish which are very costly and soyabean products are cheaper. Processing experience ranged from 1 to 15 years. This revealed that some farmers have been producing and eating soyabean for sometimes, but may not know how to process it to remove the problem associated with anti-nutritional factors. Soyabean processing technology methods are different from local methods of processing soyabean. According to the statement of some selected women

processing soyabean, their methods required soaking for 3 to 4 hours only, which is not enough to eliminate the anti-nutritional factors in soyabean. This revealed that the respondents were not aware of the danger of short time soaking and the anti-nutritional factors' problem. Their educational level and lack of social interaction may influence their level of understanding and lack of extension services for awareness. The processing technology recommendation was overnight soaking which may be up to 15 to 18 hours or even 24 hours depending on the type of soyabean products to be produced. Soaking time should be longer, while cooking time should be shorter. Soyabean is not normally cooked like other pulses because it takes several hours to become tender or cooked. Apart from removing the anti-nutritional factors in soyabean by boiling, boiling for 10 minutes in a solution of water and 0.05% of sodium bicarbonate [6,17] reduces the cooking time to as short as 30 minutes to tenderize the beans [7]. Also soaking the beans overnight before boiling will tenderize the beans and reduce the cooking time. Excessive heating may destroy certain amino acids like lysine and cystine in soyabean [3]. Cooking of soyabean is very necessary because it helps to destroy some of the anti-nutritional factors in soyabean. The soaking overnight reduces some of the anti-nutritional factors, while cooking treatments adequately eliminate the lipoxygenase and partially tenderize the beans [7].

Table 2b revealed that the majority of the respondents had only Quranic education (58%), 33% had formal education at various levels, while 9% had no formal education. It is reported that formal education enhances adoption of innovations [18]. Moreover in [19,20] it was also stated that the more education a person has the more favourable attitude he or she has towards adoption of new improved technologies. Also [21] reported that the more educated farmers are the higher there utilization of soyabean.

The regression analysis result revealed that household size and labour source were positively significant (P<0.001). This seems to be true because every member of a family is expected to take part in the family's work or business. Soyabean processing experience was negatively significant (P<0.05) (Table 3). This probably may be due to inadequate information about new improved processing methods. Other six predictors were not significant. There may be many factors responsible for this, such as inadequate extension services, lack of land to plant soyabean or lack of funds. All these constraints may affect adoption of these technologies (Table 5).

4.2 Extent of Adoption of Soyabeans Improved Technologies in the Study Area

Twenty soyabean technologies were selected and used to assess the level of adoption of soyabean improved technologies in the study area. Only three out of twenty were fairly adopted (soya *awara* 73%, soya *daddawa* 36 % and soya *kunu* 36%) (Table 4). The use of soyabean products are for alleviating malnutrition in children [10]. The goal of agricultural extension is to disseminate agricultural technologies for improving productivity, farmers' welfare and household nutritional status [22]. In the study area the few farmers planting soyabean, planted it mainly for sale, while other farmers processed it to various local foods.

Table 2a. Socio- economic characteristics of respondents in Bauchi LGA

Variables	Min.	Max	X	Sex	C.V %
Age (in years)	26	70	48.6	1.6	0.04
Household size	1.0	21	9.7	0.7	0.07
Farm size (ha)	0.1	4	0.8	0.2	0.14
Processing experience	1.0	15	4.0	0.5	0.11

Table 2b. Distribution of respondents by educational status in Bauchi LGA

Educational levels	Frequency	Percentage
Quaranic education	26	58
Adult education	4	9
Primary education	10	22
Secondary education	2	4
Tertiary education	3	7

n=45

Table 3. Regression analysis of adoption of improved soyabean technologies in processing and utilization with respondent's socio- economic characteristics in Bauchi LGA

Predicator	Coefficient	t- ratio
Constant	31.420	2.69
Age	0.024	0.28[Ns]
Education level	-0.547	0.86[Ns]
Household size	0.956	6.94[***]
Farm size	0.042	-1.18[Ns]
Processing experience	-0.365	-2.54[*]
Information source	0.063	0.03[Ns]
Labour source	0.056	4.17[***]
Awareness	-1.010	-0.77[Ns]
Social participation	-2.292	-0.90[Ns]

R^2 =78.1%*,* Ns = not significant; * = significant: P<0.005level; *** = significant: P<0.001 level

In Benue State [23] reported that many farmers were aware of the usefulness of soyabean utilization with local diets. Here the adoption was very high ranging from 6.4 to 98.7% adoption from 12 soyabean innovations considered for the study. Also in another study [24] working in Samaru Zaria showed that 80% of women adopted soyabean supplementation of soya pap and soya soup. In many other countries of the world incorporation of soyabeans in diets were adopted and disseminated by extension agents in Sri Lanka and Zambia [8,17]. Amusat and Ademola reported that the study carried out in Oniyo community in Oyo State, Nigeria revealed that there was knowledge of the nutritional benefit of eating soyabean but do not know that soyabean consumption reduces chances of cancer, obesity, ulcer and other diseases [25]. This indicates that knowledge of soyabean benefits is yet inadequate [26] in most of the communities in Nigeria. This lack of knowledge of these health benefit caused low adoption or uses of soyabean as supplement. Obviously, awareness campaign about importance of soyabean production will probably increase its consumption and knowledge of its health benefits.

Table 4. Extent of adoption of the 20 selected soyabean innovation in Bauchi LGA

Soyabean innovations	Frequency	Percentage
Soya cheese (awara)	33	73
Soya daddawa (condiment)	16	36
Soya milk	8	18
Soya kunu	16	36
Soya yoghurt utilization technologies	0	0
Soya pap	1	2
Soya vegetable soup	11	24
Soya feed	0	0
Soya baby food	3	7
Soya chin-chin	2	4
Soya kossai	0	0
Soya bread	0	0
Soya tuwo	2	4
Soya amala	0	0
Soya moin-moin	1	2
Soya danwake	2	4
Soya cake	2	4
Soya gari	1	2
Soya puff-puff	0	0
Soya pancake	0	0

Table 5. Respondents problems hindering soyabean improved technologies adoption in processing and utilization in Bauchi LGA, Bauchi State

Problems	Frequency	Percentage
Inadequate market	9	20
Insufficient funds	7	16
Lack of fertilizer	5	11
Lack of awareness (extension services)	5	11
Insects attack	4	9
Inadequate processing Equipment	3	7
Insufficient rain	3	7
No response	9	20
Multiple response		n=45

5. CONCLUSION

This study revealed that lack of knowledge about soyabean processing technologies methods and its health benefits affected the adoption of soyabean improved technologies in the study area. Other factors such as educational level and socio- economic characteristics of the people also affected the adoption. On the other hand not everyone likes soyabean probably because of the beany flavor. This might have also contributed to the poor adoption of the supplementation with local foods.

Processing knowledge and extension communication programmes will increase adoption of soyabean processing technologies in the study area and in Nigeria as a whole. According to [24] the knowledge of the extent of adoption of soyabean utilization and major factors affecting the adoption could be utilized in designing an effective awareness through extension services or education programme on soyabean utilization.

Consequently, since soyabean is a very valuable crop and can be used to improve the protein content of many foods if proper processing methods are used, the constraints affecting utilization of soyabean needs to be addressed by government and extension workers. Even if farmers were illiterate, supporting farmers with practical training and demonstrations by extension workers will make things work.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Hosken, B. Advances in soybean processing and utilization. In 12th Australian soybean conference proceedings; 2003.
2. NAERLS (National Agricultural Research Liason Services). Soyabean production and utilization in Nigeria. Extension Bulletin No. 68, ABU, Zaria. 1994;26-36.
3. Enwere NJ. Foods of plant origin: Processing and utilization with recipes and technologies profiles. Afro–Orbis Publications Ltd., Nsukka; 1998.
4. Okoruwa A.E. Income of females and rural household expenditure in South-West Nigeria. African Rural Development Monograph series. Monograph No 29. 2002;1-19.
5. Odusanya, R. Powerful benefits of soyabean: Food, beverages and seasonings. Saturday Punch, January 12. 2002;33.
6. Osho O, Dashiell KE. Expanding soyabean production, processing and utilization in Nigeria In: R.S.B Ferris (ed.). Postharvest Technology and Commodity Marketing Proceedings of a Post Harvest Conference, 29 Nov.-1 Dec. 1995, Accra, Ghana (IITA Ibadan, Nigeria). 1998;151-156.
7. Osho SM. Development soyabean Technologies for small-scale and industrial levels. A manual workshop on small- scale and industrial level processing of soyabean. Ibadan, Nigeria; 1993.
8. Weingartner KE. Processing, nutrition of soyabean. In: Singh SB, Rachie KO, Dashiell KE (eds.) soyabean for the Tropics. John Weiley and Sons Ltd., New York. 1987;149-177.
9. Ihekorange AI, Ngoddy PO. Integrated food science and technology for the tropics. Macmillian Education Ltd., London and Oxford; 1985.
10. Okoruwa AE. Integrating crop production and utilization research to reduce malnutrition: soyabean production, processing and utilization reduce malnutrition in West Africa. Invested Symposium Paper for the South Africa Nutrition Congress 2000, Durban, South Africa; 2000.
11. Fukushima D. Recent Progress in Research and Technology for Processing and Utilization of Soyabeans. The Third International Soyabean Processing and Utilization Conference (ISPUC III): 2000 of the Innovative Era for Soyabean, October 15-20 Tsukuba, Ibaraki, Japan, 2000;11-16.
12. Keay RWJ. An outline of Nigeria vegetation, Government Printer, Nigeria; 1959.
13. BSADP. Bauchi State in brief. Prepared by Bauchi State Agricultural Development Project (BSADP); 2002.
14. BSADP. Development Statistics. Bauchi State Agricultural Development Projects; 1982.
15. Ugwu DS, Nwoke UM. Assessment of Soyabean products acceptability and consumption in Orumba South Local Government Area of Anambra State,

Nigeria. International Journal of Agricultural Science and Soil Science. 2011;1(8):314-325.

16. Adegoke GO, Gbadamosi R, Ewoerhurhoma F, Uzo-Peters PI, Falade, KO, Itiola O, Moody O, Skura B. Protection of maize and soyabeans using Aframomum danielli. Journal of European Food Research and Technology. 2002;214:408-411.

17. Nelson AI, Wei LS, Weingartner KE. Home and village preparation of soya products:In: soyabean in the tropics. Singh SB, Rachie KO, Dashiell KE. (eds.). 1987;179-184.

18. Ogunbameru BO, Pandey IM. Nigerian rural women participation in agricultural and decision-making. Focus on Adamawa and Taraba States, Nigeria a wake up call. Ed. Hodges, UNICEF, Nigeria. 1992;133-184.

19. Egbugara EA. Economic status and rural women's involvement in agriculture in Imo State. Journal of Rural Extension and Development. 1993;1:87-93.

20. Agbamu JU. Analysis of farmer's characteristics associated with adoption of soil management innovation in Ikorodu LGA of Lagos State. Nigeria Journal of Agricultural Extension.1993;7:57-66

21. Ajao O, Ogunniyi LT, Adepoju AA. Economic Efficiency of Soyabean Production in Ogo Oluwa Local Government Area of Oyo State, Nigeria. American Journal of Experimental Agriculture. 2012;2(4):667-679.

22. Savile AH. Extension in rural communities. A manual for agricultural and home extension workers. Oxford; 1978.

23. Sanginga PC, Adesina AA. Manyyong VM, Otite O, Dashiell KE. Social impact of soyabean in Nigeria's Southern Guinea Savannah, IITA, Ibadan, Nigeria; 1999.

24. Atala TK, Ajia TD, Olukosi JO. Adoption of soyabean utilization innovations among women in Samaru village of Sabon-Gari Local Government Area of Kaduna State, Nigeria. Agricultural System in Africa. 1992;2:18-24.

25. Amusat AS, Ademola AO. Utilization of Soyabean in Oniyo Community of Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary. 2013;13(7):6-14.

26. Olatunji SO, Etuk UR, Adesope OM. Factors Related to Continuity in Utilization of Soya Bean Products by Farm-Families in Abia State, Nigeria. Journal of Agricultural Science. 2012;3(1):15-20.