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ANALYSIS OF INDIGENOUS USES AND AVAILABLE PROCESSING TECHNOLOGIES OF PEARL-MILLET AMONG RURAL WOMEN IN JIGAWA STATE, NIGERIA

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ABSTRACT
The study examined the indigenous uses and available processing technologies on pearl-millet among women in Jigawa State, Nigeria. A multistage sampling technique was used to select one hundred and sixty women millet processors for the study. Majority were married (73.1%), Muslims (94.3%) and with no formal education (60.0%). About 96.9% were within the age range of 21-50 years (M=40 years), mean household size and monthly income are 9 persons and N7, 069.18k respectively. About 98.0% sourced labor for millet processing from the family. Funds for business were mostly through borrowing from members of family/relatives (48.8%) and cooperative movement (38.8%). Secondary occupations is either trading (49.4%) or farming (46.9%). Larger percentage (95.0%) of the respondents belongs to one social group or the other. Most available millet processing technologies are soaking/cooking and traditional/bioprocessing (98.1%) while about 41.0% used the thermal improved processing technique. Most uses were; production of Fura, Tuwo, Kunu (98.1%) and closely followed by Ogi, Koko or Akamu (96.9%) among others. Major constraints were; inadequate capital and storage facilities (97.5%). This was followed by nomadic Fulani invasion of farm, lack of improved processing skills, insect pest infestation, processing equipment and extension contact (93.8%).Advocacy (75.6%) on uses of millet is another. Main source of awareness is family/friends/neighbors (88.1%). The study recommended that government should strengthen the extension service delivery by employing more personnel with adequate training to reduce the gap of processors and extension agent contact. Improved variety with good processing value compactable with the socio-cultural background of the respondents should be introduced with current technologies on its processing.

Keywords: Women, Processing, Technologies, Economic, Utilization and Jigawa State.

INTRODUCTION

Agriculture is important and vital to the socio-economic development of Nigeria through its focus on the sustainable livelihood of rural and urban household especially women, who are classified as vulnerable groups in the society (ICRISAT, 2015). Ducatez *et al*, (2010) reported that it is second after petroleum in contribution to nation foreign exchange earnings but contributes more to the overall Gross Domestic Product (GDP) of Nigeria. It is characterised by rudimentary farm systems, low capitalization and low yield per hectare (Kolawole and Ojo, 2007). Women play a key role in facilitating the utilization of crops through mechanical breakdown of crops into different products for ease of human consumption. Cereals are those members of the grass family, the Poeceace grown for their characteristic fruits, the Caryopsis, which have been the most important source of World's food for the last 10,000 years (Ismaila *et al*., 2010). The major cereal crops in Nigeria are rice, maize, sorghum, wheat, pearl-millet, sugarcane and fonio millet with rice ranking as the sixth major crop in terms of the land area. Sorghum account for 50% of the total cereal production and occupies about 45% of the total land area devoted to cereal production in Nigeria (National Agricultural Extension and Research Liaison Services- NAERLS, 1996). Millets (Pennisetum glaucum) are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food. Millets are important crops in the semiarid tropics of Asia and Africa (especially in India, Mali, Nigeria, and Niger), with 97% of millet production in developing countries. The crop is favored due to its productivity and short growing season under dry, high-temperature conditions. The most widely grown millet is pearl millet, which is an important crop in India and parts of Africa (ICRISAT, 2015). Pearl millet is one of the two major crops in the semiarid, impoverished, less fertile agriculture regions of Africa and south-east Asia. Millets are not only adapted to poor, droughty, and infertile soils, but they are also more reliable under these conditions than most other grain crops. This has, in part, made millet production popular, particularly in countries surrounding the Sahara Desert in western Africa (Chandrasekara *et al*., 2012).

Cereals are consumed in a variety of forms, including pastes, noodles, cakes, breads, drinks etc. depending on the ethnic or religious affiliation. The bran, husk, plant parts and other residues (after processing) are useful as animal feeds and in the culture of microorganism. Wax syrup and gum are extracted from cereals for industrial purposes. Different Nigeria ethnic groups use Millet (Cereals) residue for different purposes (Ismaila et.al, 2010).Cereals like Sorghum, Millets, Wheat, Maize and Rice are major staple foods of the most population in Nigeria and other part of Africa (ICRISAT, 2015). Pearl millet is a climate hardy crop which is grown in harsh conditions, but as a subsistence crop among mostly the poor and less privilege of the population. It is called ''Jirane'' in Hausa language. Millets are not placed as a single important commodity in the North American and European food basket at the present time, but their importance as an ingredient in multigrain and gluten-free cereal products has been highlighted.

However, in many African and Asian areas, millets serve as a major food component and various traditional foods and beverages, such as bread (fermented or unfermented), porridges, and snack foods are made of millet, specifically among the non-affluent segments in their respective societies (Chandrasekara and Shahidi 2011a; Chandrasekara *et al*., 2012). In addition to their nutritive value, several potential health benefits such as preventing cancer and cardiovascular diseases, reducing tumour incidence, lowering blood pressure, risk of heart disease, cholesterol and rate of fat absorption, delaying gastric emptying, and supplying gastrointestinal bulk have been reported for millet (Truswell 2002; Gupta *et al*., 2012). Millet grains, before consumption and for preparing of food, are usually processed by commonly used traditional processing techniques include decorticating, malting, fermentation, roasting, flaking, and grinding to improve their edible, nutritional, and sensory properties. However, negative changes in these properties during processing are not avoidable because industrial methods for processing of millets are not as well developed as the methods used for processing of wheat and rice (FAO 2012).

Therefore, with value-added strategies and appropriate processing technologies, the millet grains can find a place in the preparation of several value-added and health food-products, which may then result in high demand from large urban populations and non-traditional millet users (Mal et al, 2010). Millets were found to have high nutritive value and comparable to that of major cereals such as wheat and rice (Parameswaran and Sadasivam 1994). It has also been reported that millet proteins are good sources of essential amino acids except lysine and threonine but are relatively high in methionine. Millets are also rich sources of phytochemicals and micronutrients (Mal *et al*., 2010; Singh *et al*., 2012). For example, pearl millet was found significantly rich in resistant starch, soluble and insoluble dietary fibers, minerals, and antioxidants (Ragaee et al, 2006). It contains about 92.5% dry matter, 2.1% ash, 2.8% crude fiber, 7.8% crude fat, 13.6% crude protein, and 63.2% starch (Kaur et al, 2012). Several traditional household food processing and preparation methods can also be used to enhance the bioavailability of micronutrients in plant-based diets. These include thermal processing, mechanical processing, soaking, fermentation, and germination/malting. These procedures aim to increase the physicochemical accessibility of micronutrients, decrease the content of anti-nutrients, such as phytates, or increase the content of compounds that improve bioavailability (Hotz and Gibson 2007). This is why the study sought to investigate the women's perceived economic utilization of millet in Jigawa state, Nigeria. The specific objectives are:

- To describe the socio economic characteristics of the women millet processors in the study area.
- To identify the various perceived economic utilization of millets among the rural women.
- To assess the processing technologies available to the rural women on millet processing.
- To identify the source(s) of information on the uses and processing of millet.
- To determine the constraints of women on millet processing in the study area.

METHDOLOGY

Study Area

The study was conducted in Jigawa State Nigeria. The state was excised from Kano State on August 27, 1991. The population for the study were mainly all the millet farmers in the state. Jigawa State is one of thirty six states that constitute Federal Republic of Nigeria. It is situated in the north-western part of the country between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. The state has a total land area of approximately 22,410 square kilometers with twenty seven (27) Local Government (National Population Commission, 2006). It is bordered on the West by Kano State, on the east by Bauchi State and Yobe State and on the North by Katsina State and Republic of Niger (Ismaila *et al*., 2010). The state has a population of 4,348,649 people (NPC, 2006) while the estimated population in 2014 was 5,372,754 at 2.9% rate of population growth. Farming is among the major occupation of the people who are predominantly Hausa/Fulani and were majorly engaged in rural and subsistence farming. The topography is characterized by high land areas which is almost 750meters. Soil tends to be fertile ranging from sandy-loamy with many pockets of fadama and alluvial plains suitable for the cultivation of rice, sugar-cane, millet, maize, vegetables and sorghum etc. There are usually two seasons in the state; the rainy season lasting from June through October and dry season spanning from November to May. The mean temperature ranges from 35°C in October to about 50°C in May, while mean annual rainfall varies from 700mm to over 1000mm and can last up to 200days in some lowland parts of the state. The months of November to March are particularly cold due to dry harmattan wind.

Jigawa state is predominantly an agrarian state with over 80% of the population involved in agriculture. The major rain fed crops grown in the state includes; Millet, Sorghum, Maize, Cowpea, Groundnut, Cocoyam, Soya beans. Dry crops include; Sugarcane, Hot pepper, Okra, Tomatoes, Onions and Spinach. The major livestock kept in the state includes; Small Ruminants (sheep and goat), Poultry, Cattle etc. The major rivers in the state that provide water for irrigation activities are; the Hadejia and Katagum rivers. The Hadejia-Nguru river has the largest fadama area in Nigeria (International Fund for Agricultural Development-Community Based Agricultural and Rural Development Programme-IFAD-CBARDP, 2004). Jigawa state is divided into four ADP Zones; I, II, III and IV

- Zone I. With headquarters in Brinin kudu comprises of; Dutse, Kiyawa, Jahun, Buji, Brinikudu, Gwaram, and Miga.
- Zone II. With headquarters in Gumel comprises of; Gumel, Maigatari, Ringim, Taura, Gagarawa.
- Zone III. With headquarters in Hadejia comprises of; Briniuwa, Kirikasamma, Kafin-Hause, Auyo, Guri, Malamadori, Kaugama, Hadejia.
- Zone IV. With headquarter in Kazaure comprises of; Kazaure, Yankwashi, Gwiwa, Roni, Suletankarkar, Babura, Garki.

Sampling Procedure and Data Collection

The population for the study comprises of all the women millet processors household in Jigawa State under ADP Zones I to IV as sample frame. A multistage sampling technique was employed in the selection of the respondents used for the study. In the first stage was a random selection of two local governments from each ADP zones in the State were randomly selected to give zone 1 (Dutse and Jahun), zone 2 (Gumel and Gagarawa), zone 3 (Hadejia and Kirikasamma) and zone 4 (Kazaure and Suletankarkar) respectively. In the second stage, four (4) communities were randomly selected from each of the selected local governments. This gives a total of 32 communities. The third stage involved the random selection of five women millet processors from each of the communities which brings to a total of 160 women processors. A list obtained from Jigawa Agricultural and Rural Development Agency (JARDA) was used in the random selection at the final stage of the sampling procedure. The statistical analyses that was employed were; Descriptive statistics (percentages, mean, frequency counts, standard deviation).

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Women Millet Processors

Majority (94.3%) of the respondents were Muslims with 25.6% of them having Islamic education. About 60.0% have no formal education. This implies that they were not literate and this agreed with the findings of Singh (2007), who reported that in Makelle Ethiopia, some urban and rural women farmers have low educational status This means that that the low literacy level of the respondents would not allow for proper understanding of improved processing technology and hence lead to low adoption of the technology extended in the study area. This is contrary to the submission of Ogunlade *et al*., (2010), who agreed that women cocoa farmers in Cocoa Pod Husk Fertilizer in Cross River State, Nigeria were literate. A large proportion (96.9%) of the women were within the age range of 21-50 years with a mean year of 40 years. This means that the respondents were within their active and productive age range. This is in line with the findings of Musa *et al*., (2014) who posited that average ages of 40 years for women maize processors in adoption process in Wukari local government area of Taraba State, Nigeria. Majority (73.1%) of the women were married with household size range of 6-10 persons. Marriage confers responsibility according to Vogelstein (2013) and UNICEF (2014a & b). The average household size of the respondents was found to be 9 persons. Family is the main source of labor. This implies that more money would be saved through the availability of family labor. About 98.0% indicated that they sourced their labour for millet processing from their families. The average monthly income of ₦1,000-10,000 (86.3%) with mean processing income of ₦7, 069.18k (about ₦84,830.16k/Annum). This implies that they were not really earning better from this millet processing livelihood probably due to unavailability of processing technologies and educational understanding to cope with utilization of these technologies. Slightly below average (46.9%) were into trading (49.4%) or farming as secondary occupation, which implies that the respondents were either farmers/processors or traders/processors and this makes them to be conversant with the benefit of millet production. About 95.0% of the women are members of one social group or the other while about 84.0% claimed not to have had any form of extension service. This implies that there will be difficulty of accessing new and improved technologies on millet processing and utilization by the women millet processors in the study area. Source funds for the business were through family/relatives (48.8%) and cooperative movement (38.8%) respectively. This implies that savings mobilization is through cooperative movement and burrowing from close associates.

Table 1: Distribution of the Respondents according to Socioeconomic Characteristics

Variable	Frequency	Percentage (%)	Mean (M)
Age (Years)			
≤ 20	2	1.3	39.49
21-30	91	56.9	
31-40	55	34.4	
41-50	9	5.6	
51-60	2	1.3	
≥ 61	1	0.6	
Religion			
Islamic	151	94.3	
Christianity	7	4.4	
Traditional	2	1.3	
Educational Qualification			
No Formal Education	96	60.0	
Primary Education	15	9.4	
Secondary Education	7	4.4	
Tertiary Education	1	0.6	
Islamic Education	41	25.6	
Marital Status			
Single	1	0.6	
Married	117	73.1	
Widowed	35	21.9	
Divorced	7	4.4	
Secondary Occupation			
Trading	79	49.4	
Farming	75	46.9	
Civil Servant	5	3.1	
Artisan	2	0.6	
Household Size			
0-5	2	1.2	9.4
6-10	118	73.8	
11-15	33	20.6	
≥ 16	7	4.4	
Average Monthly Income (#)			
1,000-10,000	138	86.3	N7,069.18k
11,000-20,000	16	10.0	
21,000-30,000	3	1.9	
31,000-40,000	2	1.3	
≥ 41,000	1	0.6	
Source of fund			
Cooperatives	62	38.8	
Community Bank	8	4.9	
Personal	12	7.5	
Family/Relative	78	48.8	
Source of Labor			
Family	157	98.1	
Hired	1	0.6	
Communal	2	1.3	
Presence of Extension			
Yes	26	16.2	
No	134	83.8	
Membership of Social Group			
Yes	152	95.0	
No	8	5.0	

Source: Field Survey, 2017

Indigenous Uses of Millet by Women Processors

Table 2, shows the respondent's indigenous uses of millet in the study area. The respondents stated that millet is generally used for production of Fura, Kunu and Tuwo (98.1%). Fura which is used in the preparation of a local traditional drink in northern Nigeria, very pleasant when served chilled. This is in line with the submission of Yusufu *et al*., (2017) that Fura serves as dietary staple food and beverages for many adults in Ankpa local government area of Kogi State, Nigeria. Millet is also used for making Tuwo a staple food for all and a perfect substitute for semovita (cereal based powder used for making pasted food). So does the production of Kunu drink, which serves as alternative to soft drink especially in

region with hot weather. Majority Production (96.9%) agreed on processing into Palp due to its high nutritional content over other cereals. Palp (Ogi or Akamu or Koko) is a staple delicacy almost throughout West Africa for both the rich and the poor. It can also be blended into composite floor and mix with other food products (94.4%) to produce other good food types; for example it can be mix with yam floor, cassava floor to produce delicious paste of various types and kinds for food. Direct cooking inform of a product called Couscous is a very common staple food in the north (93.1%), followed by Dambu (83.1%) and Massa (81.3%). Millet bye products from milling can also be mixed with yam floor again for good type of Amala (the Yoruba delicacy) to be taking with vegetable (75.0%) or any suitable combination and finally, millet are good source of forage and fodder crops for feeding livestock in the study area (63.1%) as it is palatable and well accepted to the ruminants (it does not cause watery faeces). All these are in line with the work of Amadou, Gbadamosi and Le, (2011) on millet-based traditional processed food and beverages for human consumption.

Table 2: Distribution of the respondents based on Indigenous Uses of Millet

Variables	*Frequency	Percentage	Ranking
Feeding Livestock (Forage Crops)	101	63.1	8th
Production of Palp (Ogi, Akamu or Koko)	155	96.9	2nd
Production of Fura	157	98.1	1st
Processing of Tuwo	157	98.1	1st
Production of Kunu	157	98.1	1st
Production of Massa	130	81.3	6th
Production of Kunu Zakki (Soft Drink)	149	93.1	4th
Production of Waina	151	94.4	3rd
Production of Dambu	133	83.1	5th
Millet Milling Waste + Yam Flower Mixed	120	75.0	7th
Direct Cooking (Pure Millet like Couscous)	149	93.1	4th
Blended in composite floor and food Products	151	94.4	3rd

*Source: Field Survey, 2017. *Multiple responses allowed*

Processing Technologies Available on Millet Processing for Use

As shown in Table 3 on the processing technologies available for use of millet, the respondents were fully into the traditional/ bioprocessing technology that has been in existence over a long period. Soaking/cooking is very common as it is the main technology in the production of staple Ogi, Koko or Akamu and used by almost all the women (98.1%) in the study area. This is in congruent with the assertion of Amadou, Gbadamosi and Le, (2011) on millet-based traditional processed food and beverages for human consumption. Manual milling with stones or hammer mill are also common among 85.6% of the women as this is the main existing processing method of reducing the millet into particles for easy processing and consumption. Whereas, hand sieve are also used to separate the product obtained from grinding into further smaller and minute forms for easy consumption. After the milling and grinding, the product so obtained (Blended Millet with other constituents) are left for some hours to allow for fermentation in which the nutrient content of the millet is expected to breakdown into available constituents for body utilization after consumption (88.1%). Last but not the least is the mechanical processing which is similar to the milling using hammer mill but it is being done with bigger capacity powered electric motor, diesel engine or petrol engine and is being used by about 78.0% of the respondents. It is common technology across the rural areas of the state. Thermal improved processing technique is not in existence in the study area (41.2%) although it is still believed to be embedded in the traditional processing as heating is required to convert the raw product into consumable one for easy consumption.

Table 3: Distribution of the Respondents based on Processing Technologies on Millet for Use

Variables	Frequency	Percentage	Ranking
Thermal Improved Processing	66	41.2	5th
Mechanical Machine Processing	125	78.1	4th
Milling and Sieving	137	85.6	2nd
Traditional and Bio-processing (Fura)	157	98.1	1st
Indigenous Soaking and Cooking (Ogi)	157	98.1	1st
Fermentation	141	88.1	3rd

Source: Field Survey, 2017

Source(s) of Information of the Respondents on Processing and Utilization of Pearl Millet

According to Table 4, most of the respondents (88.1%) got their awareness of the processing technology of millet from family/friends/neighbors. This implies that the knowledge level of the respondents on the economic importance of millet were from their various homes through family, friends or neighbor, followed by radio (6.3%) and extension agent

(3.1%) efforts in knowledge transfer respectively. This implies that the respondents sourced their information from the cheapest sources family and radio which has a negligible cost. This is in line with the work of UNESCO (2014) that youth and rural communities make use of Radio as their means of information mostly and also Unity for Youth, (2016) asserted that most of the youth in agricultural activities first got their awareness of agricultural practices through their family/friends/neighbors in the communities where they live. Also it was supported by the work of Tenzin *et al*., (2017) who agreed that the main sources of poultry farmers' information on Avian Influenza in Thimphu City Area Bhutan are Friends/ Neighbors, Television, Health Officers/Clinic, Surveillance Groups and Radio. About 2.5% of the respondent sourced their knowledge on millet utilizations from television, newspapers or NGOs respectively. This is closely related to the findings of Musa et.al (2014) who reported that fellow farmers are the main source of information to other farmers.

Table 4: Source information of the Respondents on Processing and Utilization of Pearl Millet

Variable	Frequency	Percentage	Ranking
Radio	10	6.3	2nd
Extension Agent	5	3.1	3rd
Family/Friends/Neighbor	141	88.1	1st
Television	1	0.6	5th
Newspaper	1	0.6	5th
NGOs	2	1.3	4th

Source: Field Survey, 2017

Constraints of the Women on Processing of Millet for Use

Table 5, shows the constraints to millet processing in the study area. It can be seen among the array of constraints that, inadequate storage facilities/technology for the raw and processed millet products, and inadequate capital to purchase the millet among processors (97.5%) were seen as the most severe challenges. This implies that the absence of storage facilities would compel the respondents to sell their output quickly even at a ridiculous prices to avoid spoilage, since they done have enough capital to purchase same. Then insect pest infestation, Lack of quick and effective processing methods, affordability of processing equipment and intrusion of the nomadic Fulani cattle men and extension contact (93.8%) were experienced by of the women respectively. This implies that the impact of extension services is very scarce in the study area and this will make it difficult to spread improved varieties and technologies on this crop to the people in the study area. Majority (75.6%) agreed that inadequate advocacy on millet as to the nutritive properties and qualities to foster further research and development of improved strain are difficult is another problem, although recently, there were new release of millet from Samaru Zaria Kaduna State to farmers in Nigeria (DailyTrust, 2018). This was why lack of improved varieties (55.0%) were seen by slightly above average of the respondents as a bottle neck. Transportation and sustainability of the business for those on commercial production of Ogi, Akamu or Koko is another challenge because the millet are not always available all year round and if they are seen at all, it would be on an exorbitant basis coupled with. Availability of raw material (millet) was also not seen as a challenge since slightly below average (42.5%) of the respondents agreed with this assertion.

Table 5: Constraints of the Women on Processing of Millet for Use

Variables	Frequency	Percentage	Ranking
Inadequate Capital	156	97.5	1st
Inadequate improved Varieties	88	55.0	4th
Inadequate advocacy on the crop	121	75.6	3rd
Nomadic Fulani Invasion of farm	150	93.8	2nd
Lack of quick and effective processing Method	150	93.8	2nd
Affordability of processing equipment	150	93.8	2nd
Availability of raw material in the market	68	42.5	6th
Inadequate Storage facilities/technologies for millet products	156	97.5	1st
Inadequate Extension Contact	150	93.8	2nd
Poor Transportation Systems	75	46.9	5th
Sustainability of the Millet Processing Business	75	46.9	5th
Insect Pest Infestation	150	93.8	2nd
Low Literacy level of the respondents	75	46.9	5th

Source: Field Survey, 2017

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, the following conclusions were drawn: Millet is useful for the production of several food products like Fura, Tuwo, Ogi, Massa or can be mix with other food products due to its high nutritional value among the cereals. Majorly, the traditional/bioprocessing, soaking and cooking, fermentation, milling and sieving were among the only available technologies for millet processing and utilization

while the thermal processing is not really available (41.2%) to the respondents in the study area, although there have been no major improved technology on millet processing as a nutritive food except for the post-harvest processing technologies. The major source of awareness was from their indigenous background from family, friends and neighborhood interactions (88.1%). The respondents were extremely poor as can be seen with mean income of #7,069.18k (86.3%). Key identified constraints were; no capital to purchase the millet either for planting or consumption, storage facilities/technologies for the millet and its products (97.5%) amongst others. It is therefore recommended that government at state and local government tiers should strengthened the extension service delivery by employing more personnel (especially female extension agents) with adequate training to improve the gap of farmers to extension agent contact in the study area. Improved and high yielding varieties of millet should be introduced to farmers with current technologies if any on millet production and utilizations. Varieties should be compactable with the socio-cultural background and the local variety used by the people.

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