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Profile Characterization of a Millet Variety Good for Fura "Millet Food Drink"

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Abstract

Pearl millet is rich in vitamin A, Fe, Zn and high-quality proteins. It is the staple food crop for the majority of the Nigerien. It is processed into various finished products, including Fura, a popular food drink in Niger, predominantly part of Hausa diet. This work aims to identify the main traits of the millet variety sought by actors of Fura value chain. The methodology consisted of collecting data using a questionnaire administered to populations of 142 millet grain producers, 140 Fura processors/resellers and 140 Fura consumers selected in 14 sites and 28 focus groups. The results showed that 99% of producers are men, 90% of consumers are men and 100% of processors are women. Actors in the sample have an average age of 46 years and a basic level of education, mainly traditional Coranic and primary school. Millet local varieties are still predominantly used in the production and manufacture of Fura. The processing of Fura is done in several stages from winnowing to making dumplings. Cooking is the most delicate stage which requires more attention to obtain good Fura. Main traits of millet variety expected by actors of Fura value chain are large grains size, cleanliness, white or reddish coast and consistency, high yield, early maturing grains, etc. In addition, the grains must be suitable for Fura manufacturing process, particularly hulling and easy cooking of the millet flour balls. Breeding of new millet varieties suitable for making Fura should consider a large number of these traits in order to increase diversity, supply, improve and sustain nutritional quality.

Keywords: Millet Varieties, Traits, Manufacture, Fura, Value Chain

1. Introduction

Pearl millet (*Pennisetum glaucum* (L) R. Br.) is the most produced cereal in Niger [1, 2] with more than 65% of the total sown area [3] and more than half of total cereal production [4, 5]. It is tolerant of harsh climatic conditions, particularly low rainfall [6], [7] and can be grown on poor soils in arid and semi-arid tropical regions [2, 4]. However, millet growth and productivity can be hampered by other constraints including diseases [3, 8, 9, 10], mainly fungal diseases such as millet downy mildew [*Sclerospora graminicola* (Sacc)] [11], insects such as the ear miner caterpillar [*Heliocheilus albipunctella* (De Joannis), [12], stem borers (*Coniesta ignefusalis* (Hampson)) [13, 14], parasitic weeds [4] and birds [10].

In addition to these characteristics, millet has a higher nutritional quality than most cereals [7, 15, 16]. Indeed it is rich in vitamin A, Fe, Zn and quality proteins, including lysine and tryptophan [4, 17]. It is the main cereal consumed by more than 75% of Nigeriens [3, 5, 18]. It is therefore a staple food crop in Niger with a consumption of 240 to 280 kg per capita per year [4].

Millet is mainly consumed in various finished products ranging from flours to products such as couscous, [4, 17] millet balls "Millet drink". Several types of millet balls can be made depending on the objectives set, including "Fura" which is mainly a Hausa traditional dish. Making Fura in the traditional way follows a number of manufacturing processes: Winnowing the millet, hulling, grinding, cooking and compacting. Fura is diluted with a little water and milk, adding other optional ingredients according to consumer preferences. It can be consumed fresh, fermented or alcohol beverage [17] and as a main dish or as a dessert [15].

To address some of the production constraints and insure quality standards for good Fura, millet breeding programs have focused on the development of stable, high-yielding varieties [4] resistant to biotic and abiotic constraints. The current breeding model is often based on the "top and down" approach, transferring knowledge from "scientists" to producers. This type of approach is criticized because it neglects the preferences of the main actors in the value chains [4]. Breeding should be iterative and participatory thus taking into account the demands of actors involved in the value chains. This will ultimately provide a range of quality products corresponding to respective desired attributes and needs [4]. This work mainly aims to identify, in participative manner, the main attributes of millet varieties suitable for making a high quality and nutritive Fura, on the basis of the preferences of the value chain mains actors.

2. Materials and methods

The methodological approach used is mainly based on the bibliography and data collection through surveys of the main actors in the value chain of the millet ball "Fura."

2.1 Bibliographic research

The bibliographic research consisted of the synthesis of scientific articles and technical reports. It was completed through consultations and exchanges with main experts in the production and processing of millet have also been consulted. Cross-synthesis of data made it possible to identify areas of large millet production, manufacturing and consumption of Fura. This allowed for a good representation and sampling and also served as a basis to properly structure the interview guide to organizes focus groups and questionnaires for individual interviews.

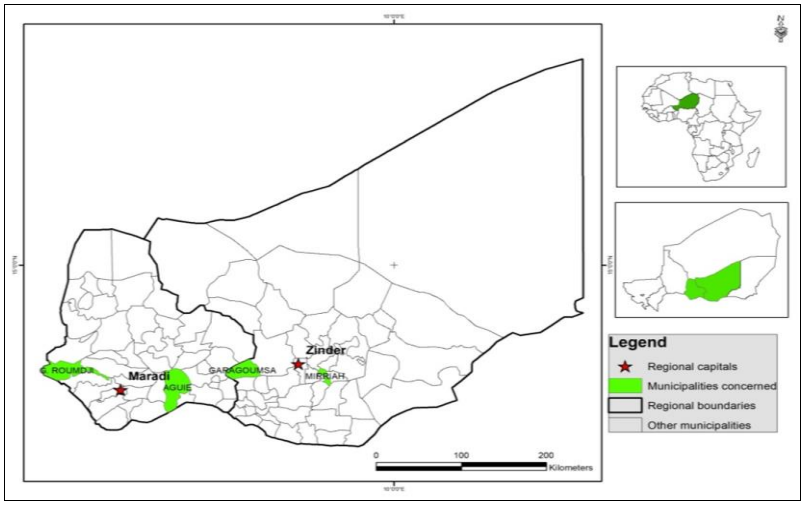

Fig 1: Map of study area

2.2 Study area

Statistical data from Agricultural Directions are used to determine the study area. These data clearly showed that both rural and urban zones of the regions of Maradi and Zinder are the main areas of millet production and Fura consumption. Four Departments, 2 per region, had been selected systematically not only based on empirical knowledge of the quality and quantity of the ball consumed but also on the existence of sufficient numbers of actors allowing to collect data by link of the Fura value chain. Eight villages, 2 per Department, had been randomly chosen using the Excel spreadsheet but readjusted in the field due to accessibility constraints and insecurity matters in some villages (See Fig 1).

2.3 Sampling

At the first level, the main links in the Fura value chain were selected to take into account the concerns of all stakeholders. At the second level, a random draw was made at each link to select the stakeholders to be interviewed.

The sample size was mostly limited mainly by the budget constraint. Seventy questionnaires were administered per link at the level of each region, making it a total of 140 questionnaires per link and 420 questionnaires for the three links in the two regions.

In addition, two focus groups were organized, one with consumers and another with processors/resellers. They were organized in 8 villages, 4 departmental municipalities and 2 urban municipalities selected for this study.

2.4 Data Collection, processing and analysis method

Two tools were developed as part of the primary data collection: Interview guides used in focus groups and questionnaires for individual interviews. The data thus collected were aggregated by link, i.e. 142 questionnaires for the producer link, 140 for the processor link and 140 for the consumer link. A total of 422 individual questionnaires were completed in the two regions. Similarly, the data collected by focus groups were aggregated by consumer and processor link. Fourteen consumer focus groups and 14 processor focus groups were conducted at the data collection sites.

Table 1: Sampling

Value chain actors	Maradi	Zinder	Totals
Consumers	70	70	140
Processors	70	70	140
Producers	72	70	142
Focus group consumer	7	7	14
Focus group processors	7	7	14

The collected data were entered and cleaned using an Excel spreadsheet. Qualitative, descriptive analyses and summaries were produced by type of data collected and by link. Then, they were synthesized and harmonized to determine the main results specific to the attributes sought by all the actors in Fura value chain.

3. Results

3.1 Sociological characteristics of the actors

The consumer link is dominated by men (90.71%) and a few women (9.29%), whose average age is 51 years. While the processor/reseller link is totally dominate by women (100%) with an average age of 40 years, 80% of whom are married, 9% are widows, 7% are singles and 4% were divorced. The producer group is made up of 99% men and 1% women, all married with an average age of 49 years. The other social characteristics (ethnic groups, level of education) are summarized in Fig 2. The samples are mainly made up of Hausa, whom have a Coranic education level of education and very few of them have reached university level.

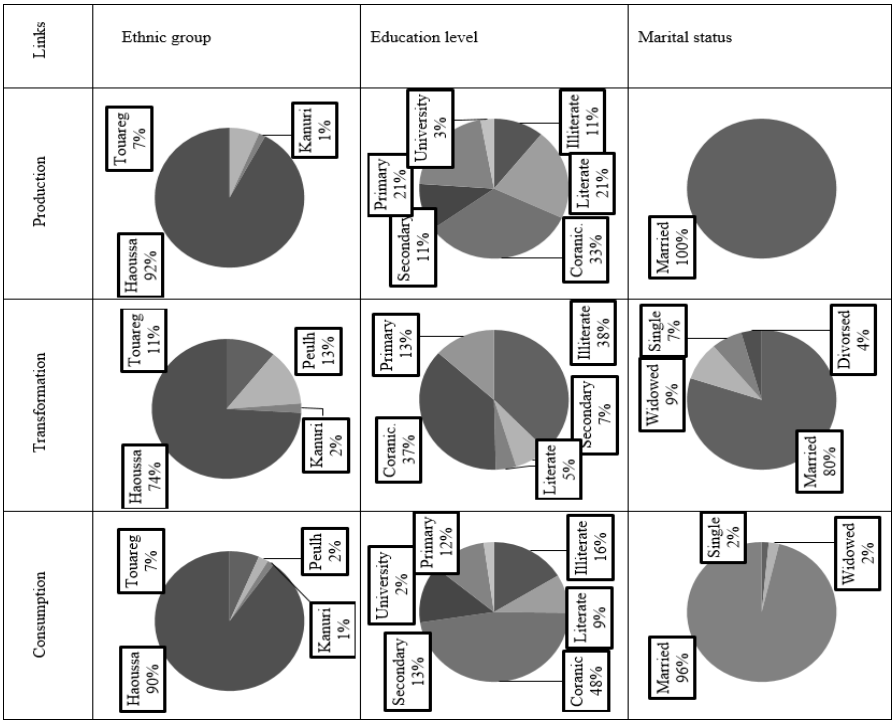

Fig 2: Sociological characteristics of actors of the Fura value chain by link

3.2 Choice of millet varieties for cultivation

Pearl millet is always produced in association with other crops (sole millet cropping is exceptional and for specific reasons like seed production for example). The millet/cowpea association is predominant because it gives the best millet (43%), followed by millet/sorghum (30%) and millet/groundnut (27%). More than the majority of producers (82.39%) choose the millet seed they sow, of which 54.93% always use the same seed and 45.07% different seeds each cropping season. Seeds sown are most often from mass selection of traditional varieties, notably Zongo, Ba Angouré, etc. Only 17.61% of the producers use seeds of unknown origin which means that the source and quality are not controlled. The use of improved seeds (like HKP, Ankoutess, Zatib, SOSAT) is rare. Indeed, very few producers buy improved seeds and some are using when they get them for free mostly from government or other agencies. The choice of varieties is made by producers based on certain criteria. The main selection criteria are the production cycle, grain yield, consistency, size and color of grain. Early varieties with high yield, with large size and consistent grains, reddish or whitish in color are best appreciated by producers.

3.3 Varieties used for making good Fura

Fura can be made from most local varieties (Zongo, Ba Angouré, etc.) and improved varieties (HKP, Ankoutess, etc.). More than 80 % of producers, 78% of processors and more than 64% of consumers say they have used improved varieties at least once to make Fura.

Identifying the millet varieties used to make Fura is easier for producers since they process their production. Seventy two per cent (72%) of producers prefer HPK and Zongo to make good Fura. These varieties have good yields, large, light grains, easy to process, rich in flour and nutritious. On the other hand, identifying the millet varieties used for Fura is difficult for processors since more than 56% of them are not millet producers and hence cannot clearly distinguish between varieties. They buy millet mainly at markets or from millet producers. Furthermore, 61.15% of processors do not know the origin of the millet they are using to make Fura. Identifying the millet variety of the Fura purchased by consumers is thus even more difficult. More than 99% of them do not know the variety of millet used to make the Fura they consume.

54% of processors prefer the local varieties (Zongo, Ba Angouré, etc.) for making fura, 28% prefer improved

varieties (Ankoutess, HKP, SOSAT) and 3% prefer varieties from Nigeria. 56 % of producer's prefer local varieties, 41 % improved varieties and 3 % none.
The best grain millet to make Fura is chosen based on grain size, color, consistency, shape and cleanliness.

3.4 Main stages of Fura manufacturing

The manufacturing of Fura begins with the choice of millet varieties according to the grain size, color, consistency, shape, cleanliness and the span period of the grain storage. The process is always the same for more than 78.57% of the actors and varies for only 21.43% of them. It is done in several stages (Fig 3) with some variations:
It begins with winnowing or washing which consists of separating the millet grains from impurities such as glumes, sand, stones, etc. This stage is done manually using gourds, valves. Most of the actors (92.5%) carried out winnowing and only a few (7.5%) simply wash the millet grain.
The next stage consists of hulling through which the millet grains are peeled to separate starchy albumen from the bran (husk). This is done using two methods. First, millet is pounded mainly by hand (mortar and pestle, 71.43%) but also sometimes by machine (mill, 28.57%). Then, the pounded millet is winnowed manually to obtain the starchy albumen and bran. It is the second most important step to make good Fura.
Milling, the third stage, consists of the manual (64.29%) or mechanical (35.71%) transformation of the starchy albumen into flour. The best milling is manual, using pestles and mortars. It is the best way to produce clean flour of very good quality. Before milling, ingredients are added to create the desired flavor. Thus, 57.14% of processors add cloves, ginger, pepper and *Xylopia aethiopica*, to give a good taste, a good smell and improve the nutritional quality of Fura. However, 35.71% of the actors do not add ingredients at this stage. The flour thus obtained is sieved and pounded thereafter to obtain fine particles (100% of the actors) and homogeneous flour, facilitating the compaction of the small clouds and their cooking.
The molding of the flour consists of manually making medium-sized clouds (balls) facilitating the next cooking stage.
Cooking is the most important, more delicate stage that requires more attention. All the actors (100% of them) agreed upon this stage being the upper most importance in the process of making good Fura. The clouds must be delicately placed one after the other in a pot containing water brought to ebullition. Several energy sources can be used. The most appropriate energy source is wood according to 100% of the processors. This source provides a low and constant fire without smoke, etc.). The level of cooking of the clouds is observed by several indicators. The reddish color is the best visual indicator and the most used to judge the level of cooking of the clouds. Breaking the clouds is sometimes used by certain actors to physically observe their level of cooking. Else and even rarely practiced, the aroma, flavor and viscosity of the boiling water are sensory indicators used to attest the level of cooking of the clouds.
Then, the cooked clouds are crumbled either in the cooking pot or placed in a container (calabash, mortar, etc.) to cool them before compacting them.
Compaction begins with the crumbling of the clouds, their cooling and then pounding only manually with a pestle and mortar to obtain a good finish paste of Fura.
The last step consists of making the dumplings by hand.

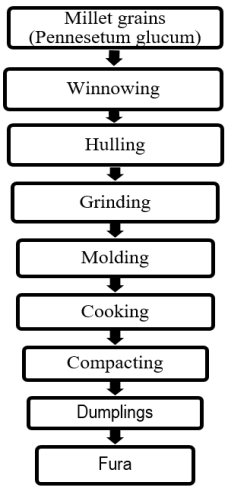

Fig 3: Diagram for making good Fura

The manufacture of good Fura must necessarily respect all these processes with skills. The millet must be properly winnowed and hulled before transforming it into flour of fine and homogeneous particles used to make clouds before cooking them over low heat.
Good quality Fura is one that is well cooked, soft, clear and clean. It must be of homogeneous texture, not sticky, reddish or light in color, giving off a pleasant aroma/odor similar to the smell of grilled fresh millet grains. In addition, good Fura should be tasty ("gardi in Haoussa"), etc. It can be stored for an average of 60 hours in ideal storage conditions. It keeps well in a cool place, in the form of balls or diluted in containers especially traditional (calabash) covered and well ventilated.

3.5 Millet grain attributes for good Fura according value chain actors

Millet grain must have a certain number of qualities and aptitudes to facilitate its transformation into Fura. These aptitudes vary slightly depending on three main links in the Fura value chain, namely millet producers, processors/sellers and consumers.Eac h group of actors per link constitutes a pole of appreciation of the variety of millet, its aptitudes to facilitate the transformation processes and the quality of its Fura. The visual attributes sought for by all actors (high frequencies) are the grain size, its consistency and its color as presented in Fig 4.

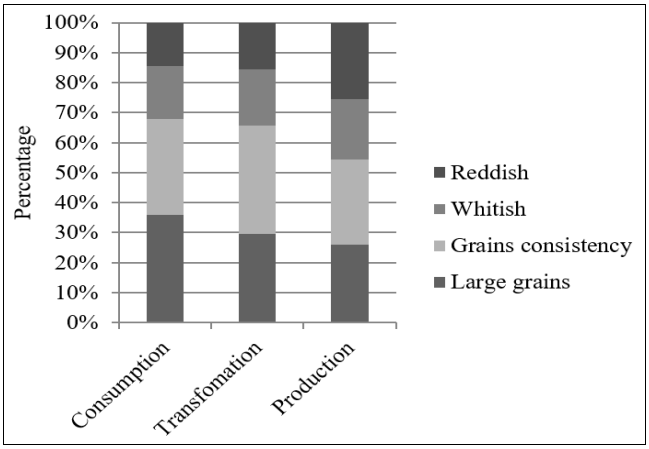

Fig 4: Most frequent attributes according all links

In addition, other less frequent visual attributes such as the round shape of the grains, the color of the hilum, etc. are recorded at the level of all the links. However, some attributes are specific to certain links. At the level of the production link, the frequency of agronomic characteristics is high. The actors of this link would like to have early varieties of 65 days cycle, with long ears of around 88 cm, well filled with grains and which give high yields of approximately 1.25 t/ha. At the level of the processing and consumption link, the ability of good hulling, good yielding capacity of white/reddish flour and easy cooking are the most sought parameters.

4. Discussions

The millet production system in association with other crops is very interesting in terms of millet yields. The results indicate that the millet/cowpea association improves millet yields. These results are corroborated by the work [19] on millet crops in strips alternated with cowpea and the work on suitable densities of millet and cowpea in millet/cowpea cropping systems [20]. Millet benefits from the legume particularly cowpea which being a cover crop hinders weed development and by nitrogen fixation process restores soil fertility [21, 22, 23, 24].

The results show that traditional varieties are still present and dominant in cropping systems, which is in accordance with those of [25]. Similar results were also reported by [26] clearly showing the persistence of local varieties such as the long-cycle Zongo despite the reduction in the length of the rainy season. Traditional varieties are well appreciated by most actors in the Foura value chain. They are important sources of the genetic diversity observed in millet. In addition, they are potential donors of the genes sought for by the actors of the value chain such as desirable organoleptic traits.

The procedure for transforming millet into good Fura is complex. The manufacturing stages are almost identical in Benin [27], Burkina Faso [17], Nigeria [15, 28] and Ghana [29]. Slight differences exist in the type of ingredients added and the type of finished products. As a result, the quality, the presentation and the color of Fura also vary. Some add spices at specific stages, particularly at the milling and compacting stages. Some add cloves, ginger at will to give a good flavor and good smell and others add red pepper to get some coloring in the finished product. Fura is regularly made fresh [30] in accordance with the fura manufacturing procedure of [27, 31]. This type of fura is consumed fresh the same day of its manufacture or a few hours (on average 12 hours) after its manufacture to allow its fermentation (alcoholic) in the open air under natural conditions or by diluting with additions of curdled milk and water. This fermentation technique is identical to that observed in Nigeria and Burkina Faso but different from that presented by [29] in Ghana, which consists of the fermentation of millet flour before milling.

Agronomic performances including grain size, high yields, grain color are among the attributes desired by actors in the millet value chain. These traits are taken into account in many plant breeding programs or purification upon ecotypes like mass or genealogical selection and then by improving performance by recurrent selection [4, 7, 31, 32]. Resilience to climatic constraints, such as earliness of varieties is also desired by most actors in the Fura value chain in accordance with the results of [4, 32]. On the other hand, several other attributes sought by actors in the value chain, grain consistency, flour yield, processing ability, are not well exploited by selection procedures. The Participatory Varietal Selection reports only the end of the selection procedure to retain high-performance varieties.

5. Conclusion

The main actors in the Fura value chain use most of the available millet varieties to make fura. However, local varieties are the most appreciated by all of the actors. The local variety "Zongo" is the most preferred by majority of actors in this value chain. The improved varieties are relegated to the second plan since only partially appreciated by a few links. The variety HKP is the most appreciated by producers but not as much by consumers and processors.

The manufacture of good Fura is delicate, regardless of the quality of the variety used. Each stage requires special attention. However, cooking is the most delicate stage that must not be missed to make good Fura. The clouds must be delicately placed in the pot containing boiling water and cooked well over low wood heat. Also, the use of traditional tools (pestle and mortar), gives better quality Fura than the use of modern tools (machines) during the stages of hulling, milling and compacting.

This work has the merit of succinctly identifying the main attributes sought by the different actors of the links of the Fura value chain in terms of suitable varieties of millet and its qualities for the manufacture of a good Fura. The main traits of the millet variety expected by the actors of this value chain are mainly large-caliber, consistent, whitish or reddish and clean grains, in addition to traditional performance (yield, precocity, etc.). In addition, the grains must be suitable for the processing steps, in particular hulling (pounding and separation of bran) and easy cooking of the clouds.

Breeding programs of new millet varieties should take into account a large number of characters/attributes in order to increase diversity and supply of millet varieties suitable for the manufacture of Fura.

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