Report of Training on Rice Postharvest Loss Reduction and Mycotoxin Control in Cereals, 5-9 December 2022

Organized by the Grain Quality and Postharvest Technology Unit of the Africa Rice Center, Mbe station, Bouake, Cote D'Ivoire

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Training on Rice Postharvest loss reduction and mycotoxin control in cereals at the Africa Rice Center, Mbe Station, Bouake, Cote d'Ivoire from 5-9 December 2022.

1. Introduction

Rice postharvest loss is a major challenge contributing to food insecurity and poverty in rice production countries in sub-Saharan Africa. In the evaluation of rice postharvest losses in sub-Saharan Africa in 2014 and 2015 production seasons, the Africa Rice Center revealed that over 47.6% of the rice produced was lost at the operational steps from harvest to storage under farmer practices. This loss was further valued economically to a whopping 10.4 billion USD. In addition to the gravity shown in this study, it was also realized that rice postharvest is under researched and that postharvest research capacity in the countries was weak. In order to contribute to the capacity building of the postharvest domains in sub-Saharan Africa, the Africa Rice Center organized a training for 13 SSA countries, inviting twenty-seven participants (13 being women) with respect of gender inclusion.

1.2. Objectives of the training

The overall aim of the training was to build the capacity of young researchers and technicians in sub-Saharan Africa to prevent postharvest losses along the rice value chain in their respective countries.

1.3. The specific objectives were:

1. Train participant to understand the physical, chemical, cooking and sensory quality traits of rice;
2. Leverage theoretical and practical knowledge on improved rice postharvest technologies (equipment and practices) innovations, rice-based products and business opportunities that contribute to minimizing postharvest losses in rice sub-Saharan Africa;
3. Conduct theoretical and practical sessions on mycotoxin control and the rapid detection of different mycotoxins in cereal grains using sensitive and reproducible methods; and
4. Promote experience sharing and networking among the different postharvest teams across the countries.

2. The training

2.1. Day 1: Monday 5 December 2022; Understanding rice Quality and Practical sessions at the grain Quality and Postharvest Laboratory

2.1.1. Opening Remarks: Dr Aminou Arouna

The session was opened by Dr Aminou Arouna on behalf of the Mbe station Head of station at 10:08 am. He gladly welcomed the 26 participants from 13 countries across Africa, the two interpreters and the 7 members of the organizing team led by the head of the Grain quality and postharvest technology laboratory of Africa Rice, Dr Ndindeng Sali Atanga. Madam Dalie Lucie was in charge of logistics and housekeeping of the participants.

In his welcome speech, the chair underlined the alarming food insecurity figures for Africa, mentioning that the number of undernourished people had rose from 32 M to 56 M in the last decade owing to pandemics and conflicts around the world. He further stated that this food insecurity is further aggravated by the huge food loss registered from harvesting to consuming, which measures up to 1/3 of the total food produced. In line with the commitment of the Africa Rice Center to contributing to the achievement of the sustainable development goals and more specifically the zero-hunger goal, one of the strategies to reach these is the reduction in postharvest losses. As such under the West and Center Africa Initiative project is to train rice value chain actors on effective strategies of reducing postharvest losses for all foods. He ended by wishing all the participants fruitful exchanges during the five days training and a good stay in Bouake.

This was followed by introduction of the participants. The participants had rich and diverse backgrounds ranging from grain quality specialists, food science and nutrition scientist, food technologists, agricultural mechanization specialists and food quality certification specialists.

Dr Ndindeng Sali Atanga on outlining the objectives of the program for the five days of training expressed immense gratitude to the Plant Health and Rapid Response to Protect Food Security and Livelihood, the Transforming Agrifood Systems in West and Central Africa and the CGIAR system for funding the training. The overall objective of bringing the participants together is to bring the rice postharvest loss problem to the forefront as it has been neglected in the past.

It was emphasized that the objectives were flexible and the organizers were opened to suggestions and any amendments.

This was followed by the group photo and the first coffee break that lasted for 20 min.

Figure 1. Group photo of participants on the first day of training at the Mbe Station, Africa Rice Center, Bouake, Cote D'Ivoire.

After the group photo and coffee break, the first module of the training was presented by Dr Ndindeng Sali Atanga; Head of the Grain Quality and Postharvest Laboratory at Africa Rice Center. The module was entitled: Understanding Rice Quality Traits

Under this module, the presenter showcased the different types of rice in markets across Africa and the quality traits that are used for their description. The rice types were

- Paddy
- Brown rice,
- Milled or polished rice categorized into white or parboiled rice.

The first rice quality trait which was used to classify rice into different categories was the Length to width ratio (LWR) that segmented rice as a function of shape:

- Slender; For slender grains, the LWR ratio has to be > 3 (unitless as it is a ratio). This is applicable in rough rice (paddy), brown and milled rice.
- Medium; For medium grains, the LWR has to lie between 3 and 2 that is 3<LWR>2
- Bold; In the case of bold or round grains, the LWR is strictly less than 2 (LWR <2).

In the markets, rice can also be described as low quality or high-quality rice. This applies to white or parboiled milled rice. Low quality rice is one that is not uniform in terms of color, grain dimensions, has damage grains and impurities with a high proportion of broken grains. On the other hand, high quality rice is one with uniform appearance in terms of color grain dimensions, in clean without damaged grains and is well packaged.

Another quality trait that also permits the classification of rice into different types is color. Under this descriptor, rice can be defined as white, yellow, brown, red or black.

Chalkiness is also another quality trait that can be used to define rice types. A rice variety can be chalky or not chalky. A chalky rice variety is one whose grains present white spots or marks on the belly or back of the milled grain. Chalkiness is a genetic trait, may occur in some varieties due to abiotic stressors that results in uneven filling of the starch granule but can disappear during appropriate parboiling.

The presentation ended with Aroma as an important quality parameter that divides rice types into aromatic or not aromatic rice. Aromatic rice varieties generate a characteristic flavor as a result of the presence of volatile molecules in their chemical constitution.

Comments, questions and answers

Under this session, it was also complimented that rice could be classified as a function of end user needs in relation to market price and more clarifications were thrown on rice shape description with the precision that cut offs for paddy, brown and milled rice were different for the slender, medium and bold categories. In line with the objective of the training, it was emphasized that low quality rice entails that actors have incurred losses at some point along the value chain. A question came up on whether or not the Africa Rice Center research was built to dispatch her technologies to users in the different countries to produce rice of the rightful quality. To this it was responded that the results from Africa Rice Center are geared to farmers to permit them produce rice that meets consumer demands in their respective countries. To the question

on what basis can a rice variety be considered as of poor quality? It was responded that if a rice variety is good for a particular end product (e.g. bread, beer or cookies), it should not be regarded as of poor quality just because it isn't suitable for another (e.g. boiled rice). A question was asked on what can be done to ensure sustainability in rice quality at all levels? There is need to have a common definition for rice quality and to understand the methods of analysis, the norms (standards) and hold defaulters responsible for breaking the norms. To this, it should be noted that the prime role of postharvest specialist is to identify critical points of quality maintenance and to inform breeders on the specific traits to target in order to select the right rice varieties for the markets. After the Q&A session came the second module:

2.1.2. Paddy quality and methods of analysis

The following parameters are used to evaluate paddy quality:

1. Moisture content:

Moisture content is the amount of water contained in a rice grain. Moisture content is analyzed through basically two methods; use of a moisture mete and drying oven method. Moisture content is an indicator for milling quality and suitable storage: A moisture content of 14% gives the highest head rice during milling. The MC of 12% is best for paddy destined for long term storage. If the MC is greater than 14%, the grain is too soft to withstand milling pressure and if the MC is less the 14% the grain becomes fragile and breaks easily during milling. An important factor to look at when dealing with moisture content in grains is moisture shrink which is measured as:

$$\text{Moisture shrink} = (\text{Initial MC}-\text{Final MC})/(100-\text{Final MC})*100$$

Moisture shrink is an indicator of weight loss and is important for millers and actors when buying paddy in the order of tons (large quantities). For instance, rice at 16% Mc indicates a loss of 4Kg for every 100Kg rice bought to be stored for long after drying to 12% MC. Moisture shrink can also be used to correct or standardize agronomic yield by always adjusting the MC to 14%. This is because agronomist tend to report yield immediately after harvest (18-22 % MC) most often without strict regards to moisture content, and millers evaluate turnover at 14% MC thus creating a huge gap that is seen as a loss incurred by the farmer. Therefore:

- Farmers should be trained to know that moisture content affects price and over drying of paddy entails loss of Kg by the farmers
- Farmers should master and use the concept of moisture shrinkage to coordinate operations in the rice value chain to maximize business turn over

At this point, all participants at the training were urged to develop a clear strategy to communicate with farmers and millers on how to deal with moisture content and the use of moisture shrink in their respective countries

- Farmers should know the link between moisture, weight and price and as such be able to use the moisture shrink (loss in water = reduction in weight) to adjust the price per Kg of paddy.
- If necessary, which is often very rare, farmers or millers should be able to equilibrate moisture which involves the combination of temperature and relative humidity (RH). This was in response to a question from one of the participants from Uganda who asked; "How can moisture content be equilibrated to 14% if overdried to for instance 10% MC?

  The following parameters were presented as indicators to evaluate varietal purity:

  1. The LWR for grain shape
  2. Based on 1000-grain weight

Thus, to measure varietal purity, the actors should:

1. Measure Length or width and calculate the percentage of grain with significant difference in length or width compared to the entire sample.

2. Measure 1000-grain weight (constant for a variety) and determine the percentage difference in weight with respect to the reference sample (100% purity).

If a line was of low varietal purity, it will lead to:

- Low initial dehulling efficiencies,
- A higher percentage paddy in the milled sample
- Uneven whitening
- An overall low grade of milled rice
- Low germination rate and poor agronomic response

To ensure varietal purity and stability over long seasons, postharvest specialists should work with breeders to identify the traits or attributes of importance demanded by the consumers and thus the market. Through this collaboration, the role of the postharvest specialist is to severally screen the breeders varieties for grain dimensions (LWR) used to define purity which shouldn't be less than 96%, amylose content (accompanied by the method used), Head rice yield, chalkiness, color (whiteness), peak viscosity, final viscosity, setback viscosity and gelatinization temperature and texture (hardness and stickiness). Other routine analysis can be added to these parameters to define a complete profile for the breeder's line and include cooking time, grain elongation ratio after cooking, swelling ratio, protein content, phytate and mineral composition. Causes/sources of variability in varietal purity. Varietal purity can be affected by environmental conditions which disrupt grain filling during starch synthesis or by mixing due to negligence from the farmers. Varietal purity is also jeopardized by impurities, cracked or damaged grains. The damage can be caused by fungi, insects, heat or water stress. If the combined effect of these parameters reduces the purity of the variety to 4% and above, then the paddy is defined as poor quality.

During the evaluation of impurities, always separate organic from inorganic impurities. In addition to impurities, cracked and damage grains, discolored and immature grains are also sorted and weighed during the evaluation of paddy quality.

Questions, answers and discussion

1. What are the strategies used to overcome the issues that deter with variety purity?

Answer: The organization of the rice value chain to reinforce standards. This can be promoted for example through contract farming or new business models directly linking the farmers with the buyers

2. Can weight not be used as an important criterion on its own to define physical grain quality?

Answer: Weight cannot be used a physical quality parameter because it is the denominator on which all other parameters are derived. It is from a defined grain weight that all quality parameters are evaluated, for instance, 1000-grain weight, 50 g to evaluate grain dimensions with the Rice statistical analyzer etc.

Comment 1: There exist standards for the sampling of 100 Kg, 1000Kg, 5 tons etc. of rice stocks for quality analysis that all postharvest specialist should know,

Comment 2: In Benin, rice paddy buyers already pay attention to MC control. This workshop has added other parameter that should also be considered like impurities, damaged grains, grain shape and varietal purity. I have also learnt that rice quality check should not be used only after milling.

Comment 3: One of the participants from Nigeria made a statement on the situation in his country wherein there exist two supporting systems; specific weight evaluation that involves taking weight of individual grains and observing whether or not there exist wide variability and mostly used by breeders and secondly the 1000-grain weight for use by millers. After this the participant added that each country should take on itself to report or communicate the issues of rice quality in their respective countries following the adoption of the same standard protocols for the taskforce to be able to present the state of rice quality in Africa.

3. On the issue of adopting international standards: Do we need to reduce or compromise our standards?

Answer: On the contrary, each African country should upgrade it's rice quality demands and aggregate the standards at a continent wide scale to be able to fight against dumping. When rice and other grains (including even other foodstuffs) are rejected in other countries of the world because they are not meeting quality standards, Africa should not be the final destination. Africa can only put a stop to this if rigorous quality control systems with clear standard cutoffs are set and respected.

Break; 13H10 to 14H20

2.1.3. Milling quality of rice

1. Milling degree:

Milling degree is a measure of percent bran removed from the brown kernel. Milling degree affects milling recovery and influences acceptance.

Milling degree (%) = (Weight of milled rice/Weight of brown rice) *100

Milling degree is not applicable to already milled rice from the market. For market samples, the surface oil content can be used as measure of the residual bran left on the polished rice.

2. Head rice ratio and head rice yield

Head rice ratio is applied for market samples as:

Head rice ratio (HRR, %) = (weight of whole grains)/weight of milled sample) *100

Head rice yield is a measured of the quantity of whole grains obtained after milling a given quantity of paddy or rough rice. i.e.

Head rice yield (HRY, %) = (Weight of whole grains)/Weight of paddy) *100

3. Grain color

Grain color moves with milling degree. Color is measure using a colorimeter and expressed as Lab where L = lightness, where 0 = dark and 100 = white; a is green (negative a-values) to red (positive a-values); b is blue (negative b-values) to yellow (positive b-values). The L, a and b values are objective color parameters. The L or lightness value that lies between 0-100 can be correlated to qualitative of sensory description. Immature grains will give negative a value, a reflection of the fact that they appear green.

4. Chalkiness

Chalkiness describes the opaque or translucent marks found on the rice grains. Chalkiness disappears upon parboiling and cooking and does affect taste or aroma. It however downgrades milled rice quality. Chalky grains can be easily identified by observing grains on a blue cardboard background and grading using the scale below although more sophisticated techniques have been developed (Rice statistical analyzer).

Percentage chalkiness = (weight of chalky grains/weight of milled rice rice) * 100

Chalkiness is evaluated on a blue background on a scale of 1 to 9 as follows

Scale	Percentage are of chalkiness
1	Less than 10
5	between 10 and 20
9	More than 20

5. Gelatinization temperature

Gelatinization temperature (GT) is directly linked to the time needed to cook rice. GT is the temperature (GT) at which rice absorbs water and starch in the grain starts to swell irreversibly. GT is measured using Alkaline Spreading test, Rapid-visco analysis or by a Differential Scanning

Calorimeter (DSC). Based on the results, rice can be classified as having low, intermediate or high GT values as shown below:

Category	Temp ranges (oC)
Low	55-69
Intermediate	70-74
High	75-79

GT can be used to check varietal stability. High GT varieties have longer cooking duration.

6. Amylose content

Amylose if the soluble starch fraction while amylopectin is insoluble. The following methods are used to analyze amylose content:

1- Iodine binding method

2- Concanavalin A binding test

3- Near Infrared Spectroscopy

Amylose content is used to classify rice into the five amylose classes as follows:

Category	Amylose Content (%)	Cooked Character
Waxy	<2	Moist, sticky,
Very low amylose	2-9	
Low	10-20	
Intermediate	20-25	Highly preferred except where japonicas are grown
High	25-30	High Vol. Expansion, flakiness, dry, less tender

Amylose content plays a key role in determining eating and cooking quality because it intervenes with most of the cooking outcomes. It is a direct determinant of texture (stickiness and hardness) and taste and also influences the reaction of rice with other chemical components or food ingredients during transformation. For instance, when milled rice is washed with hot water, the surface amylose is lost and the grains do not stick during cooking and when rice is vaporized (rapid parboiling), the grains pregelatinize and becomes hard (retrogradation).

7. Texture and viscosity

Texture is defined by the degree of hardness/softness, stickiness/non-stickiness of cooked rice. Texture is measured with a texture meter (texture profile analysis),

Viscosity is used to determine the end use of a given rice variety. For instance, high setback viscosity foods for infant food formulation. Viscosity profile simulates the cooking process and informs on the outcome of cooked rice after cooling.

In conclusion, all the seven quality evaluators presented are used in defining product profiles.

2.1.4. Laboratory Visit: 15H20 to 16H30

The participants visited the Grain Quality and Postharvest Technology of the Africa Rice Center at Mbe Station led by the Head of the Laboratory. While in the laboratory, all the working posts, equipment and personnel were presented. The lab consisted of the Laboratory head, three technicians, three grain quality observers and a research assistant who was recently recruited to resume duty in January 2023. The standard approach used from sample reception through analysis to data sharing was presented.

When samples are received, they are sent to the quarantine service for checks and when returned to the lab the samples are stored in hermetic bags to maintain the moisture content.

The equipment in the lab was presented and the participants were urged to to pay attention to the serial number of references of the equipment as they were the standard equipment in the grain industry. For instance, the laboratory milling machine which takes 15s to dehusk 100g of paddy and 60s to polished the dehusked rice. The mill is a Zaccaria mill type.

Milling demonstration with the Zaccaria mill was conducted by the lab technician. A sample of 100g paddy at 13.2% Mc was used. After milling, the weight of milled rice was 64.88g and after separation, the head rice yied was 62.8%. After this, the following equipment was presented:

- The grinding machine (the cyclone mill),
- The S21 Rice Statistical Analyzer which uses 50g sample to analyze chalkiness, length, width, LWR and varietal purity. This equipment is used to evaluate samples such as white rice, brown rice, parboiled rice, paddy and paddy residues. For demonstration, the milled sample was demonstrated for participants to see how the equipment operates.
- The Near Infrared Kett equipment for moisture, amylose content and protein,

Questions and Answers

One of the participants wished to know the requirements to send samples to the Africa Rice Rice Grain Quality and Postharvest Laboratory for analysis.

Answer: The sample needs to be certified, dried to below 14% MC, packaged accordingly and the sending institution has to cover the shipping charges.

2.2. DAY 2: 9H19

2.2.1. First presentation: Nutritional quality of rice and mini-GEM parboiling system for enhancing rice quality in an environmentally and gender sound perspective.

Objective: Maintain or reduce nutrient loss during processing which is an aspect often neglected when assessing postharvest losses. A detail presentation of the nutritional composition of different rice types (Brown, white and parboiled milled) was done and discussed, showing the decrease in some nutrients due to polishing and the conserving in some after parboiling. These values were contrasted with daily values required by an adult person for some of the nutrients like carbohydrate, protein, omega 3, omega 6 fatty acids, the ration of 3:6, mineral values for ZN, Fe Mg, P Ca and some vitamins. Significant changes were noted in some minerals like Fe due to parboiling while others like Zn, Mg, P and Ca remained the same. Most water-soluble vitamins decreased after parboiling and as a general role, brown rice had more minerals than white and parboiled rice. White milled rice lost much of the vitamins except for pantothenic acid. An understanding of the micronutrient dynamics in rice during milling, it was conceived that parboiled rice be promoted as a food in the treatment of micronutrient deficiency since brown rice storage is challenging. In the course of this presentation information and research result was also shared on rice demand and per capita consumption in Africa as reason to orientate consumers to more nutritional options, glycemic properties of rice, risk deficiency for Ca, Zn, I and Fe in Africa[1]; a quick proposition that phytate might be the most important factor responsible for Fe deficiency in Africa. To end the presentation, the GEM parboiling system was presented as an effective option for nutritional quality and low glycemic index rice that should be scaled in Africa. The GEM technology was also presented as vehicle for the direct fortification of rice.

Comments, Questions and Answers

Questions

[1] Joy, E.J.M., E.L. Ander, S.D. Young, et al. 2014. Dietary mineral supplies in Africa. Physiol. Plant. 151: 208– 229.

1. Could you please explain more on rice fortification during parboiling and the chemistry behind the success of the fortification? Does the success of the fortification process depend on the rice variety?
2. Explain the dynamics of minerals and vitamins during long-term storage.
3. On the promotion of parboiled rice, a question was raised on the consumer preference which is not always positive for parboiled rice because of the process on taste.
4. What happens to phytates during parboiling?
5. What challenges have been faced so far during the scaling of the GEM parboiling technology and how can the technology be newly introduced in other countries?

Comment:

The data presented on the nutritional composition of the different rice types is both analyzed data from Africa Rice Center laboratories, collaborating laboratories and from the literature. On the promotion of low glycemic index foods in general and rice in particular, it is incumbent on African scientist to champion the campaign for healthy food choices as evidence from empirical studies are directly associating white rice and bread consumption to the incidence and persistence of diabetes.

There was a virtual session with participants in Madagascar, thus the questions were reserved to be answered in subsequent sessions

2.2.2. Presentations from Madagascar

i. First presentation: Effect of parboiling on the nutritional composition of rice

The components analyzed in white and parboiled rice in Madagascar were: lipid content, fatty acid profile, protein content, amino acid profile, total ash content, carbohydrate by difference and minerals. The results showed that total ash, phosphorus, Mg, Ca, and K increased for all the varieties after parboiling. There was no difference in the amino acid profile of parboiled and white rice.

ii. Second Presentation: Study on the technical acceptability of GEM parboiling system in Madagascar

The key messages retained from this presentation were that:

- The GEM parboiling technology has greatly enhanced rice productivity and consumption in Madagascar and is target as the major element to the fight against food security in the country,
- The system highly contributes to adequate nutrient intake in children and to the economic empowerment of women in Madagascar,
- In the past, parboiling was not a wide practice in Madagascar, and the few who practiced parboiling did so as a means to easily dry their rice

To evaluate the technical acceptability of parboiling in Madagascar, A sample size of 135 (70 being members of associations) producers and 126 traders were interviewed. From the study, it was seen that rice prices fluctuate through the months with four of the twelve months that make up a year expressing hikes in prices. Some 35% of traders found that the commercialization of parboiled rice was difficult because of its high price.

After the second presentation from Madagascar, the First presentation of the day**; "Nutritional quality of rice and mini-GEM parboiling system for enhancing rice quality in an environmentally and gender sound perspective"** was repeated, this time in French for the benefit of the Malagasy who were online. The discussions that followed underlined that the promotion of parboiling in any country should be based on the economic gains, the role in the reduction of postharvest losses and the its capacity to increase the nutritional value of rice. Other studies still to be carried out in Madagascar are:

- The physicochemical and microbiological analysis of parboiled rice,
- Fill the gap of low access to modern technologies,
- Effects of parboiling on storability and rice aroma and the need to define the steaming time for each rice variety.

Comments:

GEM parboiling technology is accessible. So far, there are 22 installations in Cote D'Ivoire, 9 in Ethiopia, 05 in Mali, Over 10 in Benin and 5 in Madagascar. It should be noted that there is available data on physicochemical and microbiological quality of parboiled rice (specifically on mycotoxin occurrence). To maintain rice aroma during storage, the right choice of storage

equipment and MC (12% for paddy and 8 for milled rice destined for long term storage in hermetic containers.

Coffee Break 11:40 – 11:55, Presentation by Dr Ndindeng Sali Atanga in French

2.2.3. Quantitative and qualitatively losses of rice after harvest: linking grain quality with price (value)

Through the presentation, the following points were raised:

- Through modeling with large data sets, it has been established that domestic rice is of lower value compared to imported rice across African markets.
- The value of rice in urban areas is greater compared to rural areas,
- The quality attributes driving rice value in markets across Africa are: Head rice ratio, LWR, amylose content, Lightness and color intensity. High amylose rice has been linked to a low value in most regions.

Clustering of market samples using the driving attributes of rice value

- clustering studies revealed that Nigeria has a lot of low-quality parboiled rice in the market compared to Kenya and other sub-Saharan African countries.
- Through clustering, the markets were segmented as a function of dominance in driving attributes, and it was clearly established that:
    - Grain form was very important in Cote D'Ivoire and Nigeria,
    - In Madagascar, rice generally present the same characteristics from the urban and rural markets.
    - In Cameroon, head rice is the most important attribute driving rice prices,
    - In Uganda, LWR
    - In Benin and Ghana amylose content and texture are the most important attributes,
    - In Kenya rice is very expensive and head rice is the most important attribute,
    - It was revealed that slender and parboiled rice was most preferred in all the eight countries studied (Benin, Cameroon, Cote D'Ivoire, Ghana, Kenya, Nigeria, Madagascar, and Uganda)

- In addition to grain form, medium to soft texture rice, slightly sticky aroma and lightness are preferred in Cote D'Ivoire,

Comments, questions, and answers

Comment:

The participant from Burkina Faso underlined that contrary to the report that the price of parboiled rice is higher than that of white rice, it is the opposite in Burkina Faso. How do we in Burkina Faso convince the population to understand that parboiled rice should be more expensive?

Response:

First and foremost, you have to understand that rice price is driven by its value. Rice value here entails overall quality (nutritional value and physical appearance). Once you ensure that the parboiled rice is of high quality, you can then develop channels to communicate information on the value of parboiled rice by either branding or strictly selling premium parboiled rice as a healthy or nutraceutical food. Of course, this means adequately investing in the communication. This session ended with the following assignment to all the participants:

1. Each participant was charged to develop a strategy for the management of postharvest losses in their respective countries.

2.2.4. Third Presentation: Valuation of Postharvest loss in sub-Saharan Africa and mitigation strategies, by Dr Ndindeng Sali Atanga

This presentation was the results of a study carried across five different countries in sub-Saharan Africa by Africa Rice Center in collaboration with the National Agricultural Research Institutes. Through the presentation, quantitative assessment was done at harvest, threshing, drying, parboiling, milling and storage. The severity of the losses at each of the operations was presented and the overall sum of the quantity of rice was translated to an economic value of over 10 billion US dollars[2]. At the end of the presentation, the presenter reiterated that, there is need to look for funding and repeat the postharvest loss evaluation work in more countries.

Lunch: 13H00 – 14H00

[2] Ndindeng et al. 2021. Valuation of rice postharvest losses in sub-Saharan Africa and its mitigation strategies. Rice Science, 28: 212 – 2016

2.2.5. Visits to all Africa Rice Center Research Laboratories

I. Molecular Biology and Breeding Laboratory of AfricaRIce (head of La: Dr Nana Amoah Kofi)

The participants were received by the head of the Laboratory, who did the presentation of the laboratory. The core mandate of the laboratory is to conduct breeding operations in an efficient, cost effective and timely manner to identify genes of interest as demanded by agronomy, grain quality specialists etc.

Questions

1. Do the breeding activities in the lab directly target grain quality indicators such as gelatinization temperature, aroma and chalkiness?

   Response:

   Yes, the laboratory screen down lines using molecular markers to be able to over varieties containing the desired traits by agronomist and grain quality specialists.

2. Can the tools and methods in your laboratory identify the exact genes for cooking quality and specific end uses?

Response:

Our lab uses molecular markers specific to genes controlling several traits in rice including those linked to physical quality, eating and cooking quality and chemical quality. So, if a grain quality specialist is looking for a particular trait in a variety, we can run analysis and say whether or not the gene responsible for the expression of the trait in found in the variety.

3. Is your lab interested in transgenic rice?

Response: Not the mandate of the lab.

II. Plant Pathology Laboratory (head of Lab: Dr Onaga Geoffrey)

The plant Pathology Laboratory does research in plant diseases caused by fungi, bacteria and viruses. The laboratory carries out the identification and isolation of pathogens. It was noted that each pathogen had a specific methodology of isolation and identification.

In collaboration with the molecular biology laboratory, the plant pathology lab:

- Screen rice varieties for disease tolerance,
- The molecular characterization of pathogens to understand virulence

Questions

1. Have you done any studies on the incidence and prevalence of diseases in relation to the deterioration of rice quality across Africa?

Response: Thank you for your question. We have not yet conducted a study that directly looks at rice diseases and postharvest grain quality but we have evaluated the effects of fungal, bacterial and viral attacks on rice growth performance and yield. We have also discovered new rice pathogens that were not known before. In collaboration with the postharvest laboratory, we will certainly look at pathogens attacking rice grains and their effects on the quality of the grains.

2. What is the most prevalent and/or virulent rice disease(s) from across countries in Africa?

Response: For the past three years, we have not conducted regional wide studies across African countries to identify the most virulent disease. However, In Cote D'Ivoire where we have done a lot of sample collection from the fields in almost all regions of the country, we are still isolating the pathogens after which we will identify and be able to able your question. Thank you.

III. The Soil, Water, Fertilizer and Plant Laboratory (Head of Laboratory, Dr Saito)

The laboratory was presented as one of the reference laboratories of soil analysis in the world and is one of the member labs of the GLOSOLAN consortium. The main objective of the consortium is to map the nutrient composition of soils around the world to permit agronomist to advice. Farmers on fertilizer related issues. In this lab, we do physical and analysis of soils. We also use spectra and XRF methods together with AAS to analyze soil minerals such as Fe, Zn, Mg Pb, As and all other heavy metals.

Questions

1. Have you already correlate soil nutrients to the nutrient content in rice grains?

Yes, we have already done such studies where we also looked out the nutrient content in rice biomass as a whole.

2. Do results from your laboratory permit the recommendation of NPK fertilizer doses for soils from different countries?

We do this through the use of a mobile App called RiceAdvice developed by the head of our lab.

After this, the equipment in the lab was presented to the participants and included the Atomic spectroscopy and the XRF.

IV. The Biodiversity Center for Africa (the Genebank Laboratory, headed by Dr Marie-Noelle Ndjiondjop)

This center harbors the largest genebank of rice varieties in Africa. The rice varieties are coming from all corners of the world. The current collection is estimated at 2285 accessions, 95% of which are from Africa. The Genebank lab is divided into different sections, with each section carrying out specific duties to permit the adequate sorting, analysis, packaging, labeling and storage of the accessions. The facilities we have can permit the conservation of samples for more up to a 100 year. For the long-term storage of samples, we clean the samples, evaluate the germination rate, dry to less than 6% Mc and store a < 2 °C. At these conditions, the storage duration is estimated at 20 yrs.

End of Lab visit and start of field visit: 15H30

- Visit to the seed production fields. (Fields where the JT11 and Orylux 6 are under multiplication).
- Demonstration plots of varieties already promoted in some countries like the Sahel lines which are tolerant to saline soils
- Presentation of rice varieties resistant to submergence

General comments after the field visit

- Postharvest scientist should integrate seed health evaluation in their programs,
- It was recommended that the postharvest task force been consolidated into a common network, through a WhatsApp forum for information sharing.
- Need to create a mentorship scheme for the postharvest specialists,
- Participants should endeavor to widen the scope of postharvest to render the domain dynamic
- Participants were encouraged to form solid institutional postharvest research team, integrating researchers from the universities and academic institutions,

2.3. Day 3: Improve rice Postharvest Technologies

Before the start of the session, participants were asked to present any housekeeping issues or special needs. To this, three participants raised the need to consider vegetarians during meals as there were limited options for them.

2.3.1. First presentation: Harvesting and Threshing technologies, By Dr Mapiemfu Delphine and chaired by Dr Ndindeng Sali Atanga,

Factors affecting rice harvesting were grouped into two:

Group 1: Production factors

Group 2: Harvesting factors

Group 1 factors

1. Use of certified rice seeds from approved seed enterprises. Certified seeds assure

- Varietal purity,
- Good germination
- Uniform plant growth and
- Uniform maturity

The factors used to confirm rice maturity to allow harvest at the optimum harvesting time are:

- Varietal cropping cycle,
- Observe that there is at least 85% yellowing of the panicles.
- Measure the moisture content and ensure that it is at 18-22%

Group 2 factors:

- Use adequate harvesting equipment and methods.
- Drain the fields before harvesting.

2.3.2. Second presentation: Improved drying technologies.

The most important factors to control during rough rice drying are Drying temperature and moisture content. In the course of the presentation, tips were shared on proper practices during drying for both traditional and mechanical drying technologies.

2.3.3. Third presentation: Milling methods

Information was shared on:

- One stage milling (one step),

- Two step milling

- Multistage milling machines: The different steps in multistage type mills are: precleaning, dehusking, polishing, grading, separation, mixing, mist polishing, weighing and packaging of rice.

Comments, questions and answers

Comment: The recommended MC for harvesting is 20-22% MC. It is not advisable for farmers to allow harvested panicles to dry in the field as this increase the risk of contamination by molds. For drying temperature, freshly harvested paddy should not be dried beyond 35 °C to reduce the risk of crack formation and damage to the grains. It is the responsible of postharvest specialists to train farmers to follow guidelines and protocols to preserve rice grain quality. For instance, the use of moisture meters to respect MC levels. The focus of the postharvest taskforce is to contribute to the transformation of the food system in Africa through sustainable rice intensification. This by accompanying the farmers with the best skills, equipment and technology and obliging farmers to stick to adequate standards by following protocols.

Coffee break: 12H15 to 12H40

2.3.4. Storage Technologies

Storage is an important operation for both small-scale and large-scale farmers and they should be trained on important notions around storage facilities, storage conditions and the preparation of grains for storage. The effective control of grains during storage depends on the understanding of the equilibrium moisture content (EMC). The EMC depends on temperature and relative humidity which are the most important challenging factors faced during rice storage. The Best form in which rice should be stored as paddy, as paddy rice is less hydroscopic and demonstrates a long storage duration compared to milled and brown rice.

Storage facilities

Rice storage facilities are divided into bags, bulk and hermetic systems (further divided into cocoons, silos and superbags)

1. Bag storage is of low capacity and can contain 40-80Kg of rough rice and is commonly practiced in Asia and sub-Saharan Africa with the use of jute and woven plastic bags
2. Sealed or hermetic storage systems. These are the best systems that maintain rice quality including the preservation of aroma during long term storage. To promote hermetic storage in Africa, the Africa Rice Center has distributed over one million hermetic bags in some countries in West Africa and has plans to extend the distribution to other regions. The rice sector has witnessed limited subsidization compared to the cocoa sector and this narrative has to change if we need to reach self-sufficiency and to successfully transform our food systems.

The new plan for the Postharvest taskforce is to develop a scheme where farmers can use commercialized hermetic storage facilities with large capacities as collateral to guarantee loans from the bank. Hermetic storage is most effective for rice storage because the system builds up carbon dioxide to 5% which is enough to kill all the insects in the bags. It also preserves aroma and grain viability. As a symbol of the Africa Rice system to promote hermetic storage in Africa, samples of hermetic storage bags will be shared to the participant to mark the start of the commitment.

2.3.5. Visit to technological units of the postharvest section Africa Rice Center

In the course of the visit, the following equipment were presented:

- Improved harvesters including the reaper and motorized cutters as farmer friendly technologies.

It was emphasized that for farmers to benefit from improve technologies which are literally expensive for small-scale farmers, the farmers should be clustered into groups and trained to invest in technologies. After investment, the farmers need to synchronize their farming activities and this means farmers of the same locality plant the same variety at the same time, weed, fertilize and harvest at the same time.

- The ASI Thresher, already in use in Senegal, Nigeria, Cote D'Ivoire, Burkina Faso and Mali.
- The newly acquired continuous flow dryer
- The cool temperature drying bags from GrainPro with an air inlet fan,
- The installed cocoon with a 5 tons capacity and the EcoWise monitoring devise,

- The Grain Pro sealed bags
- The flatbed dryer
- The GEM Parboiling equipment (Soaking tank, steaming baskets, pulley levers, and operating conditions (steaming time = 25 min, soaking temperature = 85 - 87°C, water 5L for 40Kg soaked paddy). This technology is already in use in Mozambique, Nigeria, Madagascar, Ethiopia, etc.
- The Ecological stoves (together with solar fans)
- The newly acquired destoners which are under testing at Africa Rice Center before supplied to the millers,
- The Dehusker and
- The rubber roll mill

Lunch 14H00 – 15H00

Comments, Questions and answers

Questions

1. Is the GEM technology freely adopted by farmers or is it always financed by projects through Africa Rice Center? Or, has any study be done on the adoption and acceptability of the technology
2. Why is it that only the GEM parboiling technology is promoted in all countries when other parboiling equipment also exist?

Answers

The GEM parboiling technology is not imposed on its users. The technology is developed with the users at the center and modified to suite their demands. The technology has undergone 15 different innovations thanks to evaluation and comments of the users and is being scaled by private companies or enterprises who continue to do modifications as demanded by the users. Other technologies have so many limits that the GEM technology have been able to over this include the use of non-oxidizable and durable material in order to meet food quality transformation standards.

2.4. Day 4: Rice-based products, Rapporteur: Dr Mapiemfu Delphine

The fourth day of training was on Thursday the 8th December. The day started at 09:07 and was chaired by Dr. Sali Ndindeng Atanga. A total of four topics were presented by Drs. Danbaba, Eyenga, Houssou and Ndindeng on rice based-products and packaging. Each presenter took about 20 min for the speech, which was followed by questions, answers and discussion. Some recommendations were also made during this day.

2.4.1. First presentation: Production and packaging of rice flour and rice-based snacks, by Dr Danbaba from NCRI, Nigeria,

He started by reminding the audience, on the overall objective of the training and the task force, which is the reduction of rice harvest and post-harvest losses. Rice-based snacks are one of the methods for such reduction, where very low market rice quality is used for value addition. He briefly compared rice flour and wheat flour in terms of gluten and size particles: rice flour does not contain gluten but can be well processed to obtain flour with very fine particles of more than 98% not larger than 212µm. Flour production following a modified method base on the Niigata technique, wet milling using attrition mills.

The steps of rice flour production

The water soaking milling technique follow the following steps: Cleaning (winnowing and washing), soaking at ambient temperature for 4-6 hrs., repeated grinding, sieving, sedimentation, drying of the sediment, pulverization, sieving and packaging. The eight steps of rice flour production were explained. Galvanized metal is used for the production of this flour, for food safety reasons. Through the presentation, the presenter showcased a series of snacks derived from rice flour by women in Nigeria.

Advantages of the use of rice flour in snacks production

Some rice flour snacks produced locally were presented. The production of rice flour in snacks uses very low market rice quality, with the following attributes to make high rice-based products and therefore increase of income. Rice starch and its products is easy to digest, Rice flour has a bland taste, Sparkling white color, Hypoallergenic properties, Low in fat, has high oil absorption capacity, Rice flour is gluten free, It can be made from broken rice fraction, therefore cheaper, Low in sodium and calories when compared when compared with wheat, Rice flour has high level of lysine. The presenter showed the steps of rice-based snacks preparation, from

weighing and mixing the ingredients, rising or fermentation, kneading, shaping, baking or frying or steaming or toasting or extrusion and finally packaging. Packaging rice flour is done using available material, although studies are still needed for more improvement.

Concerning the out-scaling of these snacks produced from low market value rice, thousands of women are actually involved in their production and selling locally.

Questions/Answers/Comments

- How is the milling of rice flour done? After soaking, wet milling is performed, using 1 volume of water for 2 volumes of rice.
- Does it mean rice rejected for consumption is used for snacks production? No, the rice used is of low market value, but consumable and it is cleaned before processing.
- In Japan for instance, rice bread is rather steamed, other alternative flour products can be used rather than wheat bread.
- How can the production time of such snacks be reduced, while improving the quality? The soaking time can be reduced with the increase of temperature, furthermore, the particles size of the flour should be very small and wet milling should be done. Also, mechanized rice flour production is being progressively put in place, particularly for drying.
- How was the best flour particle size obtained? Through the use of series of sieves analysis to measure particle size. In addition, a student is presently working on rice flour particles size and sieving, to improve the quality of small-scale snacks production.
- Could we obtain a high nutrient snack from rice four? The lysine content in rice is higher than that of other cereals, the fortification can be applied for more complements.
- Is it possible to develop a common recipe for different countries? The standardization seems a bite difficult as it depends on the processors.
- What is the strategy developed for more out-scaling? Actually, planning to couple that with the GEM parboiling technology.
- What is the self-life of rice flour produced from low market value rice? Have succeeded in storing such flour for than 7 years, although its quality has to be evaluated.

Recommendations

- Clean document on rice based-products in different countries should be produced.

- The nutritional analysis of baby food developed in different countries should be done, alongside with sensory analysis.
- Baby food produced from rice should be completely gelatinized and should not have more than 30% of carbohydrates.
- Teams will be made for the effective outscaling of these products, following a clear scientific prove of their respective quality and acceptability. This will ease the implication of the private sector to make these products found on shelves in supermarkets.
- There is a funded project on healthy food outscaling and those participants with such products should indicate to be part of it.

Comments

The chair of the presentation urged the presented to develop a technical workflow document of rice flour production and transformation to some of the products to be shared to the participants at a later date. As a general comment, it was suggested that since many innovations on rice transformation exist across the countries let country representatives document the innovation such that they can be compiled in a single document and published to the benefit of all interested in rice transformation. In addition to this, the nutrition facts of each product should be reported in order to ease the recommendation of the products to consumers. On scaling the innovations, it was stated that private companies should be targeted as a means to project the products on shelves in super markets.

Break 13H00 to 14H00

2.4.2. Second Presentation: Production and packaging of fortified rice-based composite biscuits

Dr Eyenga Eliane introduced this topic with the importance of biscuits, their large acceptability among populations. She further presented the main characteristics of rice based-biscuits, which are rich in carbohydrates, low proteins, can be made from low market value broken rice and low gluten content. To improve on the quality of these rice-based biscuit, in terms of proteins, minerals and vitamins and reduce the level of fats, safou (Dacryodes edulis) powder was used. The objective was to produced and package fortified rice-based composite biscuits, evaluate their physico-chemical properties and sensory analysis. The presenter showed

the quality of safou, the steps of safou powder production, from safou pulp cleaning, drying, grinding, sieving, packaging and conservation. She further presented the steps of biscuits production: the simple biscuits made with wheat flour and those fortified either with sour safou powder or with non-sour safou powder. All the three types of biscuits were evaluated. Two packaging materials: polypropylene and aluminum were used to store the biscuits for 5 months for their evaluation.

Main results

The acceptability of safou rice-based biscuits was higher, due to the high level of aroma and flavors from the safou powder. There was an increase in fats contents, but high level of proteins, an increase of amino-acids and minerals. After storage, biscuits produced from wheat flour were stronger than those from rice flour. The moisture content of all types of biscuits increased with time, although biscuits packaged with aluminum had lower moisture content as compare to those packaged with polypropylene. The peroxide index was low in biscuits produced with safou.

Questions/Answers/Comments

- What are the features of safou fruits? They are rich is lipids, are either acidic or non-acidic. In Cameroon, this fruit is produced seasonally and is very abundant in local markets during the production season. Safou fruits are highly perishable, they can be dry and conserved as powder. This processing is particularly beneficial for acidic fruits, which are not accepted by consumers.
- The water activity would have been evaluated for the self-life of biscuits; mean value would have been accompanied with standard errors also it would have been interesting to do a microbiological evaluation of the rice-based biscuits produced.
- For new products, it is better to start with physico-chemical evaluations before sensory evaluation.
- Was margarine completely replaced by safou powder during biscuit production? It was a partial substitution of margarine with safou powder.

Coffee break. All participants took a coffee break from 11:02 – 11:30 AM.

2.4.3. Third presentation: The production and packaging of steamed rice bread (Ablo), by Dr Paul Houssou

Dr. Houssou presented ablo as a local maize-based product, produced and consumed in Benin, Ghana and Togo. Formally, the ablo was made from maize, but now rice is used for its production. But this production is usually done at a very small scale by women and from imported rice. The objective was then to produce ablo, using locally produced rice and at a medium to large scale by women. The presenter showed the 14 steps for the production of ablo, using locally produced rice, from the selection of rice variety, cleaning and washing, water draining, grinding, sieving, preparation of pap, cooling of the pap, mixing the pap with 2/3 of the rice flour, further mixing, fermentation, shaping, steam cooking and dressing. Twelve rice varieties produced locally were tested. NERICA2, NERICA6, or V82 rice varieties non-parboiled allowed the production of good ablo. The scale of ablo production was increased from one tray (traditionally made), to six trays (improved method).

The implications of ablo production on the development

The technology of ablo production using rice is simple and allows to make light and good ablo, the use of improved steam cooker for ablo production is an efficient solution to address the low level of production using traditional method, the promotion of such technology to large scale consumers, including school canteens, hotels, restaurants, etc. will allow adding value to low market value rice, create micro-enterprise activities related to its production, etc.

Questions/Answers/Comments

- What is the steam cooking duration? It varies with the number of trays in the steaming equipment. For the 6-trays cooking equipment, the cooking time is 30 min. The ablo is introduced after the water has started boiling, the last tray is well covered to conserve heat and allow homogenous cooking.
- What is the level of ablo adoption? Ablo is highly adopted because it was formerly highly consumed. This technology has just improved on its production, by replacing the imported rice used with locally non parboiled rice. In addition, several public demonstrations have been made with high success of acceptability from consumers.

- Is there a quality analysis of ablo? Will now analyze the physico-chemical and nutritional quality of ablo.
- How is ablo consumed? It is eating with stew, rich in proteins as will content either fish or meet.
- What is the self-life of ablo? It is consumed hot, immediately after production and is not conserved.
- Is it possible to improve on the packaging of ablo? Yes, it is; but actually, leaves from plants are used for the ablo packaging and are appreciated by consumers as they improve on its aroma.
- What about the safety of the equipment used for ablo production? The tray used are stainless steel.
- What is the size of flour particles used in ablo production? The particle size has not been evaluated, but the production of ablo does not need very fine particle size.
- It is possible to use a mixture of rice flour and orange flesh potato, to improve on the nutritional quality of ablo? Yes, studies can be done to achieve that.

Recommendations

- Participants can do an exchange visit in Benin to learn on ablo production.
- Can evaluate the production of ablo from brown rice.
- Think out of the box and transform the food system in our countries. For example, develop the best option of ablo packaging, which can cross boundaries.
- In order to improve on the quality, ablo flour can be produced and packaged under vacuum sealing for its use as instant food for home consumption.
- Can improve on the nutritional quality of ablo, by adding orange flesh sweet potato, cowpea, etc. to develop effective protein rich alternative food. Research proposals can be developed from such ideas, which can also be easily pick up by industries.

2.5. Day 5: Mushroom production and Rapid detection methods of mycotoxins. Rapporteur Dr Eliane Eyenga Flore.

On Friday, December 9, 2022, we started the training on reducing post-harvest losses of rice and control of mycotoxins in cereals at 9:05 a.m. with Dr. Ndindeng Sali Atanga presenting the program, the moderator Dr. Danbaba and Dr. Tang Erasmus Nchuaji the presenter.

2.5.1. First presentation: production of mushrooms from rice by-products

He started the presentation according to the plan below:

Definition of edible mushrooms, how are mushrooms produced? How is the propagation of mushrooms carried out? The necessary material to produce mushrooms? How to cultivate mushrooms? The nutritional value of mushrooms produced from rice by-products has been presented on the recently published article.

In summary, mushrooms are fleshy, white-brown in color and usually harvested from rotten wood as food. They are rich in minerals, vitamins and antioxidants. They are produced with rice by-products such as the husk and can be a source of income for producers as 1kg of mushrooms costs 2000-2500fca. The rice husk is rich in hemicellulose and this is what promotes the growth of mushrooms. In order to successfully cultivate the samples, the following steps must be followed:

- Avoid contamination
- Make a good selection of the strain
- Isolate the animals to avoid contamination
- Sterilize the shelves and the equipment used
- Maintain the room in the dark

Comments/Questions/Answers

Question 1-We need more pictures for the demonstration

Images will be available in the final report

Question 2-What are the challenges of mushroom production

The most important challenge is to ensure total hygiene

Question 3-What are the types of bottles to be used

We use glass bottles

2.5.2. Second presentation: Rapid tests for the detection of mycotoxins in cereals

Mycotoxins are produced all along the production chain, from pre-harvest, harvest to post-harvest, but much more during the storage period. They are produced when grains are stored under inadequate drying, storage and handling conditions.

Mycotoxins are carcinogenic, nitrogenous and osteogenic. Exposure factors for mycotoxins depend on the dose, nutritional status, sex, age, and health status of the individual.

Rapid detection test steps:

- Sampling
- Sample preparation
- Extraction
- Raptor for reading
- Dilution
- Downloading of data from raptor software
- Data analysis

Question and answer phase

Question 1-is there a syndrome to indicate mycotoxins in seeds?

Mycotoxins are poisons produced by fungi, it is a secondary metabolism.

The determination of mycotoxins in the laboratory: A practical session using 10 market samples from Kenya and Uganda were used during a demonstration session to determine aflatoxin concentration.

2.5.3. Third presentation: Overview of grain quality analysis at AfricaRice Center

Dr. Ndindeng Sali, presented the different types of rice analyzed at the laboratory: rough rice or paddy, brown rice, white polished rice and parboiled polished rice. He continued by explaining the different types of analysis performed, which are physical, chemical, cooking and eating characteristics. During sample preparation, the moisture content is evaluated and rice is milled, if necessary. The following parameters are evaluated: grain dimension, varietal purity, chalkiness, grain color, amylose content, protein content, gelatinization temperature, pasting properties, cooking time, water uptake ratio, swelling capacity, texture profile, starch fraction, Fe, Zn, Mg, etc. The objective of these analysis is to obtain or valorize the types of rice that fit the

markets, either for direct consumption or for further processing into ablo, infant foods, biscuits and other snacks. The laboratory does analysis in partnership with countries like Germany and Canada. In this case, rice samples can be prepared and sent over there for analysis. In addition to the parameters listed above, the AfricaRice Center post-harvest laboratory also does sensory evaluation, which is applied for the appreciation of uncooked rice, cooked rice, texture and taste after eating. There are different methods of sensory test such as discrimination test, two alternative forced choice, product characterization, panel analysis, etc.

Under the objectives of reducing food harvest and post-harvest losses, contributing to healthy food for Africa to achieve food security, rice samples from different countries can be analyzed for free at AfricaRice Center. The AUEU collaborative project supports such objectives and how to use local vegetables for healthy food production.

Launch. Participants left for the launch and came back at 14:25 PM.

Announces were done, with respect to participants who are to leave Bouaké on the 10th December and the dinner offered by AfricaRice on Friday, the 9th December.

2.5.4. Strategies to reduce rice harvest and post-harvest losses

Under the coordination of Dr. Ndindeng, all participants suggested ideas to develop strategies for the reduction of harvest and post-harvest losses. This was done up to the end of the day, at 16:45 PM. The key points listed, with discussion on this activity are presented on a different report.

3. Conclusion

3.1. Closing remarks from the head of Rice Quality and Postharvest Unit of Africa Rice Center

Brief on the training was presented by Dr Ndindeng Sali Atanga and he mentioned:

- Understanding how to characterize rice quality
- Different technologies for reducing losses
- How to quantify losses
- Strategies on loss reductions and what innovations for reduction
- Value adding of products
- Use of rice by-products for energy and mushroom production,

- Rapid detection of mycotoxin in rice:
- Practical sessions for innovations

3.2. Evaluation statements from participants on the overall organization of the training

Grateful to participate in this rare training and happy for the introduction of new faces from across different countries. The introduction of mycotoxin training and capacity building of all the participants. Thank you to Mrs Dalie Lucie for all logistics. Thank you to Dr Ndindeng Sali for mentorship and leading the rice sector across Africa. Thank you to Dr Aminou for always being there for the postharvest team. Thank you to Dr. Futakuchi for the identification of smart leaders and the overall support to the rice sector development in Africa. In addition, one of the participants (lady) emphasize that the training on mycotoxin and postharvest losses came at the right time. Mycotoxin contamination and postharvest losses a challenge in Sierra Leon and this will succeed thanks to the collaboration with AfricaRice. Happy with the rice innovation products especially the gluten free baby foods

3.3. Concluding remarks from Dr. Aminou Arouna

The One CGIAR bent on the successful transformation of the food systems in Africa by tackling food losses. Involvement of youths and women in postharvest loss reduction strategies as a way of empowerment as enshrined in the objectives of the West and Central African Initiatives. Assurance on the continues support from Africa Rice Center and most particularly from postharvest unit and Socioeconomic units.

3.4. Concluding remarks from Dr Futakuchi

On behalf of the DG Dr Roy Macauly I thank you for participating in this training. Despite the effects of the covid 19 pandemic for the past two years we have shown resilience in postharvest reduction losses. Postharvest losses have a huge impact on the economies costing over 10 billion USD for five African countries as recently shown by Dr Ndindeng Sali Atanga. Mycotoxin research in rice in Africa is under researched and there is need to intensify work in this area.

4. Some photos of the training

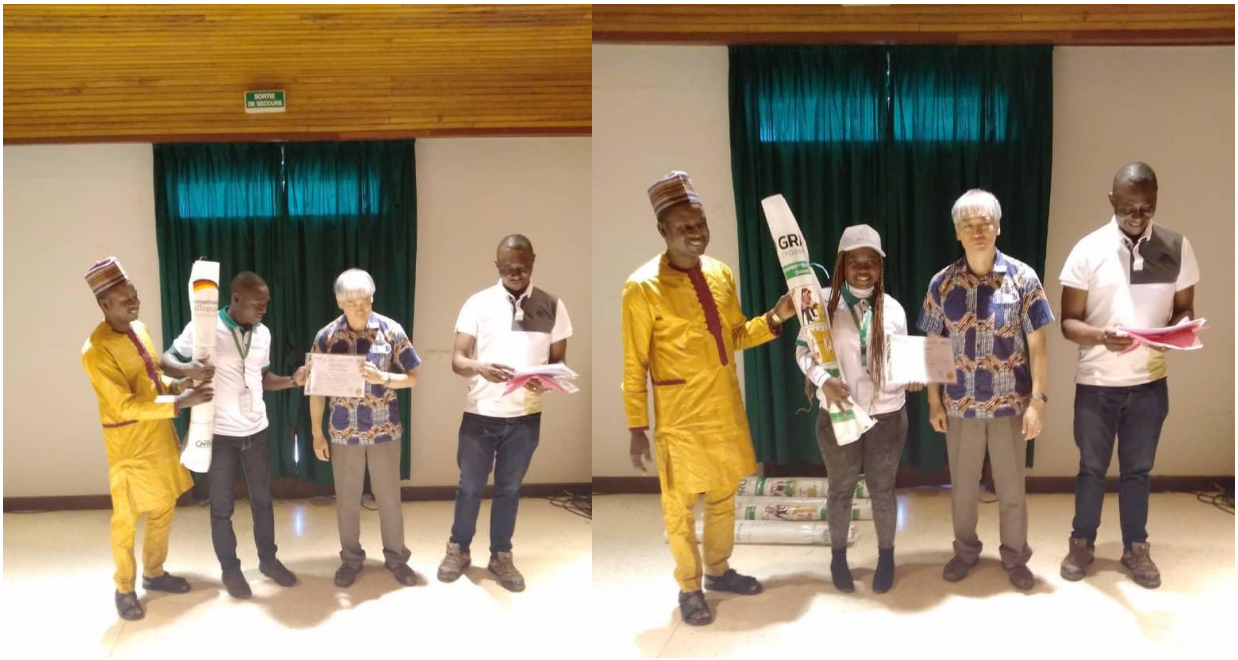
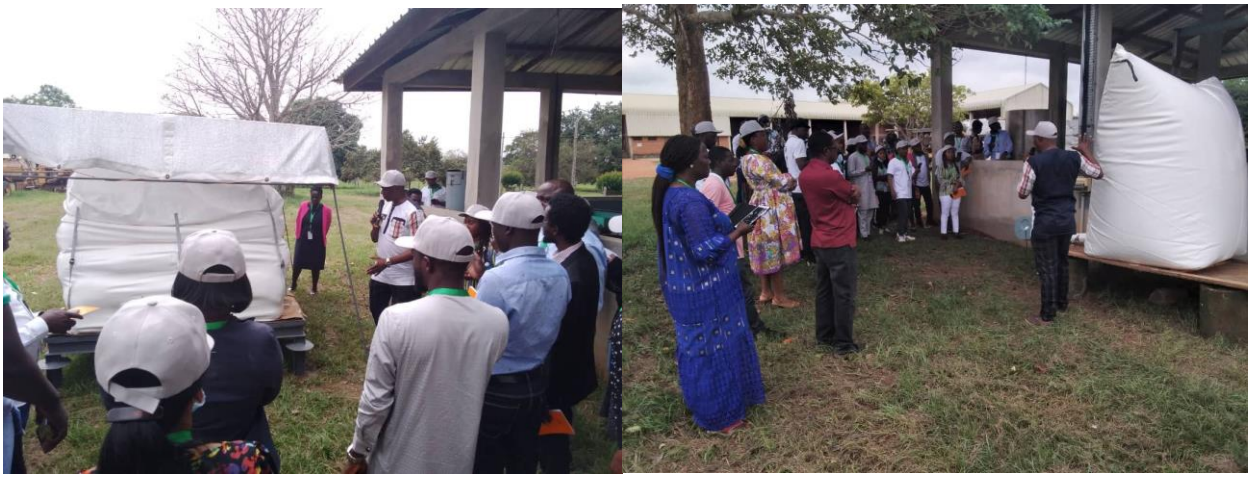


Photo 2: Presentation of Certificate of participation and hermetic bags



Photos 3: Presentation of storage cocoon and low temperature storage technologies

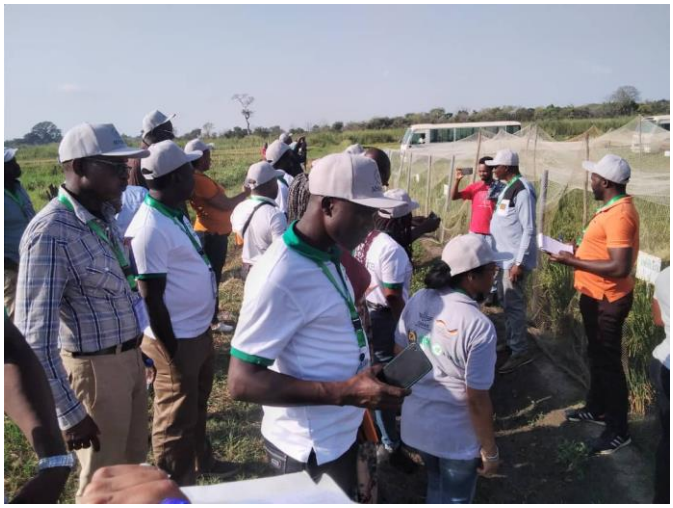
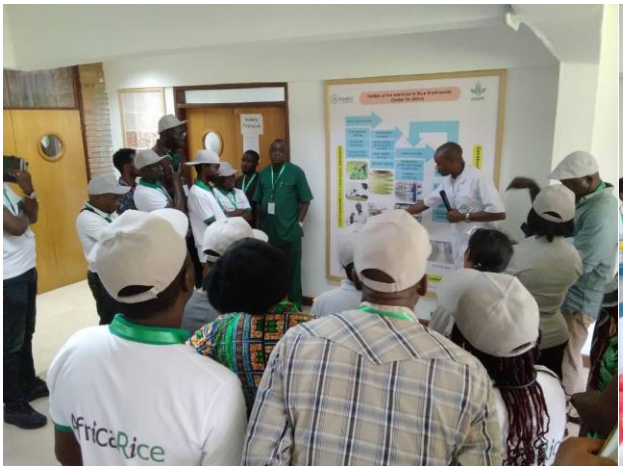


Photo 4: Visit to the demonstration plots for hundreds of rice accessions for quality analysis



Photos 5&6: Laboratory visits at the Africa Rice Center