DFID/CPHP/FRI PROJECT ON

DISSEMINATION OF IMPROVED BAMBARA PROCESSING TECHNOLOGIES THROUGH A NEW COALITION ARRANGEMENT TO ENHANCE RURAL LIVELIHOODS IN NORTHERN GHANA

(ZB0332/R8261)

TRAINING OF TRAINERS WORKSHOP REPORT

(TRAINING OF TRAINERS WORKSHOP HELD FOR EXTENSION STAFF OF MoFA and VARIOUS NGOs ON 23RD – 25TH APRIL, 2003 VENUE: MOFA-WIAD TRAINING LABORATORY, TAMALE, GHANA).

By

Nana T. Annan, Food Research Institute, (CSIR), Accra, Ghana

W.A. Plahar, Food Research Institute, (CSIR), Accra, Ghana, *and*

C.A. Nti, Home Science Dept., Univ. of Ghana, Legon

April, 2003

INTRODUCTION

The purpose of the Bambara Coalition project is to promote bambara production, processing and utilization for improved food security of poor households through the effective dissemination of processing technologies developed under a previous CPHP project (R7581). The main outputs are that high quality bambara flour (HQBF) production technologies are disseminated and promoted in northern Ghana and their socio-economic impact assessed. In addition bambara based recipes will be developed and promoted and Institutional linkages strengthened to ensure efficient collaboration between co-operating organizations, leading to sustainable mechanisms for future activities and actions. This will stimulate resurgence in the popularity of bambara and improve food security of households in rural Ghana.

One of the expected major outputs of the project is for eighteen trainers from MoFA-WIAD and various NGOs to be trained by end of April 2003, with a final training by end of July 2004. Training is to be conducted for selected Agricultural Extension Agents (AEAs) of MoFA's department for Women in Agricultural Development and five NGOs in the area. Participants will comprise 8 AEAs from WIAD of MoFA, and 2 each from The Amasachina Self Help Association, Tumakavi Development Association, CAPSARD, Gubkatimali Development Society and Tiyumba Integrated Development Association. AEAs will gain the requisite knowledge of these processing technologies and recipes to enhance their capability for community training and demonstration activities in their areas of operation. Training will be provided by the Food Research Institute on processing technologies and the University of Ghana on recipes, with assistance from CAPSARD.

The first training of trainers workshop was held in Tamale in April 2003, and this report covers all the activities undertaken during the training.

LIST OF PARTICIPANTS

1. RESOURCE PERSONS

- Dr. Wisdom Annorsey Plahar, Chief Research Scientist, CSIR-Food Research Institute, Accra, Ghana

- Mrs. Nana Tekyiwa Annan, Senior Research Scientist, CSIR-Food Research Institute, Accra, Ghana.

- Ms. Christina Antwiwaa Nti, Senior Lecturer, Home Science Dept., University of Ghana. Legon, Ghana.

2. TRAINEES

a. Ministry of Food and Agriculture Extension Staff:

i. Moiko K. Moisuab, MoFA, Tamale Municipality
ii. Issah Mohammed, MoFA, Tamale Municipality
iii. Cynthia Nagali, MoFA, Tolon-Kumbungu district
iv. Raphael Dinku, MoFA, Tolon-Kumbungu district
v. A. Mincaila, MoFA, Gushiegu-Karaga district
vi. Eric Zunzari, MoFA, Gudhiegu-Karaga district
vii. Rabi Adam, MoFA, Savelugu-Nanton
viii. Alhassan Dramani, MoFA, Savelugu-Nanton

b. CAPSARD (NGO) Extension Staff:

i. Alhassan Elizabeth
ii. John Adams

c. Amasachina Self-help Association (NGO)

i. Zenabu Shaibu
ii. Hindu Abubakari

d. Tumakavi Development Association (NGO)

i. Margaret Abukari
ii. Amankwah Belinda

e. Gubkatimali Development Society (NGO)

i. Rita Mensah
ii. Abukari Salamatu

f. Commercial participants

i. Rabiatu Haruna, Theresa Owusu Ent., Tamale
ii. Alhassan M. Ashietu, Bambara Processors Association, Tamale

3. OTHER FACILITATORS

- Mercy Falley, MoFA-Women in Agricultural Development, Tamale
- Fuseini Haruna Prince, MoFA, Tamale
- Sulemana Stevenson, CAPSARD, Tamale

TRAINING WORKSHOP PROGRAMME

23rd April 2003 – Arrival of Participants

24th April 2003

8.00 – 9.00 am Registration

9.00 am – 5.00 pm

Opening prayer … … … … … … … … N.T. Annan, Food Research Institute, Accra

Welcome Address … … … … … … … .. Prince Haruna Fuseini, MoFA, Tamale

Introductory Remarks … … … … … … … … Dr. W.A. Plahar, Project Leader, Food Research Institute, Accra

Training Session I: Nutritional characteristics and food uses of bambara groundnuts. … … … … ... … N.T. Annan, Food Research Institute, Accra

Training Session II: Local bambara recipes and their nutritive value … C.A. Nti, Home Sci. Dept., Univ. of Ghana, Legon

Training Session III: Production and utilization of High Quality Bambara Flour (HQBF) … … … … … … W.A. Plahar, Food Research Institute, Accra, and Mercy Falley, MoFA-WIAD, Tamale

- Study of the Training brochures
- Practical demonstrations

Discussion and Closing

25th April 2003

Visit to Prospective HQBF Commercial production sites

Departure

WELCOME ADDRESS

Prince Haruna Fuseini, MoFA

In a short address, Mr. Prince Haruna Fuseini welcomed participants to the training of trainers workshop on behalf of the Northern Regional Director of Agriculture. He said the growth and development of the legumes industry in northern Ghana is central to the current efforts of the Ministry. The increased cultivation of legumes, and for that matter bambara, will not only help to enrich the soil but also improve on the nutritional status of the people through the consumption of relatively inexpensive, high protein food. He was confident that the new knowledge that the participants were about to acquire will help address a number of livelihood constraints facing the majority of rural poor in northern Ghana as a result of the decline in bambara cultivation.

INTRODUCTORY REMARKS

W.A. Plahar, Project Leader, Food Research Institute, Accra

In his introductory remarks, the project leader stressed the importance of bambara in the farming systems of the rural poor, especially those in the northern sector of the country where the crop has played a major role in the livelihood of many farm families. Bambara, he stated, has several advantages over cowpea not the least being its resistance to crop and post-harvest pests. However, for more than a decade bambara production has been in decline, principally as a result of its poor processing characteristics; it takes a very long time to cook bambara groundnuts. He remided participants of how traditionally, cooking bambara at the homestead required a great deal of wood for fuel and large volumes of water. Such constraints have mitigated against bambara production, a very high value crop and excellent source of protein. This decline in production has been replaced to some degree by the cultivation of cowpea but this pulse is difficult to store and is susceptible to insects pests, and so is generally sold quickly after harvest. Despite the increase in cowpea production, the decline in bambara has led to a reduction in income generation as farmers no longer

obtain the high prices that are available towards the end of the storage season. This has put the food security of many farm families in northern Ghana at risk.

Dr. Plahar suggested that the processing problems associated with food preparation can be overcome if producers switch to using bambara flour rather than whole grain. He said flour production requires soaking and boiling the pulse for less than one hour, whereas cooking whole bambara requires overnight preparation. He further informed participants of the outcome of a previous two-year CPHP project (R7581), where a collaborative efforts of research scientists from the Food Research Institute of Ghana (FRI) and the Natural Resources Institute of the UK (NRI), as well as food processors and NGOs in northern Ghana resulted in the development of a proven technology to facilitate processing of bambara into a high quality bambara flour (HQBF) that has several nutritional, functional and physiological advantages over the traditional bambara flour. Various stakeholders, including producers, nutritionists, representatives of women's groups, millers, NGOs and other extension workers, at a workshop held in Tamale in 2002 concluded that promoting the use of high quality bambara flour (HQBF) would stimulate demand for bambara and reverse the decline in production.

Women in northern Ghana, he said, do not possess the knowledge or skills to prepare HQBF nor do they know how to utilise the flour in recipes. The main goal of the current project therefore is to overcome these constraints, to provide women with the knowledge to allow them to make the best use of bambara. It is supposed to provide farmers and food processors with income-generating opportunities for improved livelihood. It will stimulate resurgence in the popularity of the crop and provide farmers with confidence to enable them to increase bambara cultivation. Additional cash from sales will improve food security of households in rural northern Ghana and in other bambara producing areas. Promotion of the developments will improve access to knowledge of bambara processing technologies. The purpose of the workshop, he said, was therefore to train extention staff and provide them with adequate knowledge of the production, quality characteristics and uses of the HQBF in order to facilitate widespread dissemination of the technology in all the communities where the participants operate as trainers. He concluded with the hope that the sessions to follow would be highly participatory and stimulating.

TRAINING SESSION I:

NUTRITIONAL CHARACTERISTICS AND FOOD USES OF BAMBARA GROUNDNUTS

By N.T. Annan, Food Research Institute, Accra, Ghana

INTRODUCTION

Bambara groundnut (Vigna subterranea), an indigenous African legume grown mainly by subsistence farmers is often considered to be under utilized and neglected. In Ghana it is cultivated in the coastal savanna zones where rainfall ranges from 800 to 1200 mm as well as in the nothern regions of the country where it is grown as a mixed crop with sorghum and millet (Doku, 1996). Bambara is found to be better adapted to semi-arid or arid conditions than locally competing grain legumes making it more important as a food security crop. The lengthy periods of soaking and boiling to make them edible is however, one of the major constraints in the use of mature bambara seeds. Household preparations may involve cooking some seeds for over 48h - 72h even after pre-soaking Studies by Annan et al. (2001a) showed that the cookability of bambara was significantly improved by *kawe* (a natural rock salt) treatment. Soaking for 3h in 0.3% *kawe* solution reduced the cooking time of the hard-to-cook maroon variety of bambara from two hours to one and a quarter hours (a reduction of about 40% cooking time) while at 0.5% concentration of the salt solution, the cooking time was reduced to only one hour.

The market potential of bambara will be greatly enhanced when more food uses of the crop are developed. A high carbohydrate (65%) and relatively high protien (18%) content as well as sufficient quantities of fat (6.5%) make bambara groundnut rank highly as a complete food. Food uses in nothern Ghana include boiling immature seeds with addition of a little salt, boiling and crushing of dry seeds into balls or cakes and frying for use in stews. In southern Ghana the dry seeds are usually soaked overnight, after which they are boiled until soft and used in stews.

This aspect of the training workshop is intended to equip the extension staff with the requisite knowledge on the quality characteristics and current and potential food uses of bambara.

NUTRITIONAL AND PHYSICAL CHARACTERISTICS OF BAMABARA

The nutritional and physical characteristics of bambara are presented in Tables 1 and 2, respectively. In an earlier study bambara purchased in local markets in the north could be separated into eight groups based on seed coat colour (Plahar et al., 1998). The three categories of bambara used in the present study were selected based on their relative abundance on the market.

Table 1. Nutritional composition of bambara varieties

	Bambara variety		
Component	Cream black-eye	Black white-eye	Maroon white-eye
Moisture (%)	5.8 ± 0.2	6.5 ± 0.2	6.8 ± 0.2
Protein (%)	17.6 ± 0.3	20.6 ± 0.4	18.1 ± 0.4
Fat (%)	6.1 ± 0.5	4.3 ± 0.5	6.7 ± 0.5
Ash (%)	3.0 ± 0.3	3.3 ± 0.3	3.4 ± 0.2
Carbohydrate (%)	67.5 ± 0.5	65.3 ± 0.5	65.0 ± 0.5
Energy (kcal)	395.3 ± 2.1	382.3 ± 1.1	392.7 ± 3.1
Calcium (mg/100 g)	73.0 ± 4.5	62.1 ± 1.1	57.1 ± 2.0
Phosphorus (mg/100g)	245.2 ± 1.1	282.6 ± 7.7	284.2 ± 4.7
Iron (mg/100 g)	3.0 ± 0.2	6.0 ± 0.2	5.6 ± 0.4
Tannin (mg CE/g sample)	4.1 ± 0.1	13.5 ± 1.8	5.4 ± 0.6

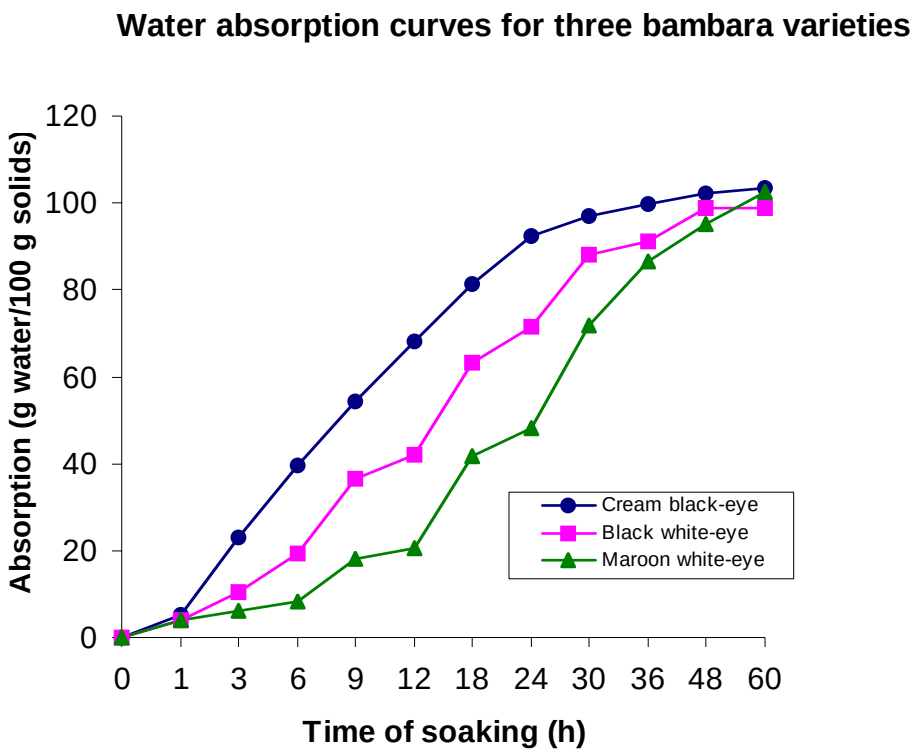
- Bambara is a complete food and when promoted will help meet the nutritional needs of poor farm families with little or no supplementation
- It is important to stress this property as one main reason for the promotion

Table 2. Physical characteristics of bambara varieties

	Bambara variety		
Component	Cream black-eye	Black white-eye	Maroon white-eye
Seed coat colour	Cream	Black	Maroon
Seed coat thickness (mm)	0.12 ± 0.02	0.20 ± 0.02	0.20 ± 0.01
Thousand seed weight (g)	742.2 ± 40.6	841.3 ± 15.2	923.5 ± 12.2

- The physical characteristics, which will make for easy identification are as shown in Table 2.
- The cream black-eye bambara is smaller with a thinner seed coat than the black white-eye and maroon white-eye, which have similar sizes and seed coat thickness.

WATER ABSORPTION CHARACTERISTICS OF BAMBARA VARIETIES



- Water absorption is an important functional property of bambara. Knowledge of these properties will facilitate a proper choice of a variety for a specific food use.

- Some bambara varieties such as the cream black eye absorb water very fast while the maroon white-eye is observed to be a slow absorber. However, as shown in the curve all the three varieties reach a maximum water absorption capacity by about 60 h of soaking.

- It is important to assist the food processors to choose the right bambara variety for the intended use.

ESSENTIAL AMINO ACID COMPOSITION (g/16 g N) OF MAJOR LEGUMES

The amino acid composition of bambara is compared with other major legumes in Table 3.

Table 3. Essential amino acid composition (g/16 g N) of major legumes[1]

Amino acid	Bambara	Soybean	Groundnut	Cowpea
Isoleucine	4.39	4.54	3.38	3.82
Leucine	7.83	7.78	6.40	7.04
Lysine	6.45	6.38	3.54	6.83
Phenylalanine + Tyrosine	9.10	8.08	8.88	7.78
Methionine + Cystine (s-aa)	2.80	2.59	2.40	2.26
Threonine	3.49	3.86	2.61	3.60
Tryptophan	0.86	1.28	1.04	1.09
Valine	5.30	4.80	4.18	4.53
Limiting amino acid	s-aa	s-aa	lys. & threo.	s-aa
Protein content (%)	20.3	39.2	25.6	25.0
Protein score (%)	79.7	73.6	65.1	64.2

[1]Reference: FAO, (1982)

- The protein score refers to the amino acid score of the most limiting amino acid. Like most legumes the sulphur amino acids (s-aa) are the limiting amino acids in bambara. However, the level found in bambara was higher than that found in the other major legumes.

- Even though bambara has the lowest protein content among the major legumes shown in the table (Table 3) it has the highest protein score. This makes bambara a better quality protein food. Protein quality relates to the efficiency with which various food proteins are used up for the synthesis and maintenance of tissue proteins (Jansen, 1978).

- A protein score of 79.7% indicates that about 80% of the bambara protein is available for the body's metabolic activities when consumed while only 65% is available when groundnut or cowpea protein are consumed.

PASTING PROPERTIES OF BAMBARA FLOUR

In the northern part of Ghana, bambara is used mainly in the form of a paste. A study of the pasting properties of bambara flour will help to understand how the starch granules will behave when heated and hence the suitability for a variety of dishes.

- Different varieties behave differently when heated due to differences in their starch strength. A comparison of the pasting properties of the different bambara varieties with cowpea is shown in Table 4.

- From the table, it is observed that bambara starch granules begin to gelatinise at higher temperatures (82.7°C) than cowpea (77.5 °C). It also takes a longer time for gelatinisation to begin in bambara (38.5 min) than cowpea (35.5°C). This means when bambara flour is used in weaning foods for example it will take longer for thickening to begin when heated than when cowpea is used.

- At 95°C cowpea flour attains a much higher viscosity than bambara. The maroon bambara variety showed the lowest viscosity characteristics hence much more of this variety will be required in weaning formulations to achieve the desired consistency. This is quite desirable as a higher nutrient density will be achieved when enough bambara is added to attain the desired consistency.

Table 4. Pasting characteristics of bambara varieties and cream black-eye cowpea

	Cowpea	Bambara variety		
Pasting characteristic	Cream black-eye	Cream black-eye	Black white-eye	Maroon white-eye
Gelatinisation temperature (°C)	77.5	82.7	82.7	82.7
Gelatinisation time (min)	35.5	38.5	38.5	38.0
Viscosity @ 95°C (BU)	344.0	180.0	110.0	72.0
Peak viscosity (BU)	360.0	-	-	-
Time to peak viscosity (min)	46.4	-	-	-
15-min viscosity @ 95°C (BU)	260.0	248.0	182.0	152.0
Starch stability (BU)	100.0	-68.0	-72.0	-80.0

- No peak viscosities were reached for bambara flour indicating a strong starch stability of the flour. The flour can thus be whipped vigorously without losing its aeration capacity. From practical experience it has been observed that in the preparation of 'Koose' (a fried bean cake) more whipping is required to attain the desired consistency when bambara is used than when cowpea is used.

SENSORY CHARACTERISTICS OF BAMBARA FOOD PREPARATIONS

Food uses of bambara in Ghana include boiling of seeds with addition of a little salt or other spices, known as *Aboboe,* frying or steaming of the bean paste known as *Koose* and *Tubani,* and use of the flour in bakery and weaning foods. Sensory evaluation of some of the above mentioned food preparations is given in Tables 5 and 6.

Table 5. Mean sensory scores for boiled bambara (*Aboboe*)

	Bambara variety		
Sensory attribute	Cream black-eye	Black white-eye	Maroon white-eye
Taste	7.2 ± 0.8	6.4 ± 1.6	7.5 ± 0.8
Aroma	7.6 ± 0.9	6.8 ± 1.2	7.2 ± 0.8
Mouthfeel	7.4 ± 0.9	6.4 ± 1.6	7.3 ± 0.7
Texture	6.4 ± 1.2	5.9 ± 0.9	6.5 ± 0.7
Appearance	7.0 ± 0.9	5.7 ± 0.8	6.7 ± 0.6
Overall acceptability	7.3 ± 0.9	5.9 ± 0.9	7.2 ± 0.7
Degree of liking	Like moderately	Like slightly	Like moderately

Interpretation of scores: 9 = like extremely; 1 = dislike extremely

Table 6. Comparison of mean sensory scores for *Koose* from *bambara* and *cowpea flours*

Sensory attribute	**Bambara *Koose* (cream black-eye)**	**Cowpea *Koose* (cream black-eye)**
Taste	6.2 ± 0.5	8.1 ± 0.7
Aroma	7.2 ± 0.5	7.9 ± 0.8
Colour	7.8 ± 0.7	8.2 ± 0.5
Sponginess	4.6 ± 0.3	7.5 ± 0.6
Appearance	7.3 ± 0.7	7.6 ± 0.6
Overall acceptability	6.8 ± 0.8	8.4 ± 0.6
Degree of liking	Like moderately	Like very much

Interpretation of scores: 9 = like extremely; 1 = dislike extremely

- From Table 5, it is seen that *Aboboe* prepared from the black bambara variety is less preferred to that from the cream and maroon varieties. The sensory evaluation was conducted by consumers in the southern part of Ghana where the black bambara variety is less common. This accounted for the lower sensory scores for *Aboboe* from black white-eye bambara. This variety is however, acceptable in the north of Ghana, however, *Aboboe* is a popular dish in the south and not in the north.

- *Koose* was prepared from the cream bambara variety to make it comparable with the cream cowpea variety. Sensory scores as shown in Table 6 indicate that *Koose* from the cowpea variety is preferred to that from the bambara variety for all sensory attributes evaluated. The lower sensory scores for bambara *Koose* are attributable to the quality of bambara flour used. The bambara flour used was merely milled with no prior treatment, however, a High Quality Bambara Flour (HQBF) has since been produced with improved sensory properties (Annan et al., 2001b).

- Raw milled bambara flour was used in the preparation of bakery products. The results showed that the products were acceptable up to 20% substitution levels of the flour. Beany flavours in the products were detected at 50% substitution levels of the flour.

- High Quality Bambara Flour (HQBF) on the other hand has been found to have the following attributes:
    - sweet aroma and no beany or bitter aftertaste
    - no flatulence or stomach bloating effect
    - suitable for diversified food uses
    - reduced cooking time for food uses of bambara
    - more yield for traditional food preparations
    - high whipping properties.

SOME FOOD PREPARATIONS AND COOKING METHODS OF BAMBARA IN BOTSWANA WHERE BAMBARA IS ALSO AN IMPORTANT PULSE CROP

- 'Nyebu'- a snack. Immature seeds are boiled in their pods with salt until tender

- 'Setampa sa Ditloo' – Immature seeds are cooked with maize

- 'Dikgobe' – Fresh seeds of bambara and maize are soaked overnight. the bambara is boiled for about 30 min. and then maize added. Boiling continues (1 h) and then oil, salt and spices are added.

- Dry beans are wet milled to a fine flour and used in various dishes

- ‘Mosoko wa Ditloo’ – the flour is made into a stiff porridge and mixed with maize flour which is fried in oil into cakes and cookies.

- Steamed bambara cakes similar ‘moi moi’ or ‘koose’ in Ghana are also prepared but are mixed together with minced meat or vegetables before steaming.

CONCLUSIONS

- Bambara though identified as one of the world’s minor legume crops has been found to possess tremendous potential for increased contribution to human nutrition.

- Bambara is the only legume whose seeds are referred to and used as a complete food because it contains protein, carbohydrate and fat in sufficient proportions to provide a nutritious food.

- Varietal differences do exist in the physical, chemical and functional characteristics of bambara:
    - Darker seeds were found to have thicker seed coats and lower water absorption rates and higher tannin contents.
    - Bambara flours have low hot paste viscosities in comparison to cowpea.
    - Bambara flour and particularly, the High Quality Bambara Flour (HQBF) has quality characteristics for use as intermediate products in composite flours for bakery goods.

9. RECOMMENDATIONS

- There is the need to develop and evaluate more products and recipes for enhanced utilization of the Bambara.

- The nutritional properties of bambara must be propagated and marketing of bambara products intensified in higher income regions of the country.

10. REFERENCES

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TRAINING SESSION II:

LOCAL BAMBARA RECIPES AND THEIR NUTRITIVE VALUE

By C.A. Nti, Home Science Dept., Univ. of Ghana, Legon

Introduction

Bambara groundnut (*Vigna subterranean*) is an important source of protein, and is complementary to staple cereals which are low in certain essential amino acids. It also has significant levels of calcium and phosphorus. It was ranked the second most important grain legume in Ghana after cowpea. The cooking properties of bambara is an important factor which has led to a decline in its utilization, especially in the urban centres of Ghana. Observations indicate that the water absorption capacity of bambara is very poor as compared to cowpea, and the thick testa could be responsible for this. This results in long cooking periods and the effort and time required to cook and process bambara, in addition to the large quantities of water and especially, fuel needed cannot be afforded by many homemakers.

The need for the development of appropriate bambara processing technologies to address the problems with utilization and consequent decline in production was first identified under CPHP project R6503 by farmers in northern Ghana who attributed the decline in production of the crop to lack of processing technologies capable of removing the drudgery involved in its utilization. Subsequently, appropriate technologies were developed under CPHP project R7581 and these were assessed at a stakeholders' workshop in February 2002 where the urgent need was identified for extensive and effective promotion of the bambara flour technology as the most effective means to enhance bambara utilization and stimulate resurgence in its cultivation for improved livelihood.

Under a new coalition partnership arrangement for the dissemination of the bambara flour production technology in northern Ghana, it is considered very necessary to expand the utilization base of the product through the development of more end uses. As a first step, the existing traditional recipes for bambara flour in northern Ghana were identified and the preparation procedure standardised. The relevant nutritional benefits to be derived in the consumption of these bambara based foods were also

established through quality evaluation activities. This session of the training of trainers is therefore based on the results of this preliminary studies, in order to equip participants with adequate knowledge on what is already on the ground and the benefits to be derived therefrom.

Standardized Traditional Bambara Recipes

1. ***BAMBARA OBKORE (NYONGBEEKA)***

Ingredients: Bambara flour, Cooking oil, Salt petre (Kanwe), Beans Leave, Onion, Salt and Pepper

Method: Pound bean leaves and kanwe until mashy, mix bean flour with pounded bean leaves, make balls out of the mixture, wrap in leaves and steam, heat oil, add onions, pepper and salt. Serve hot

Nutritional quality (per 100g): Protein (11g), Fat (3.8g), Carbohydrates (38.4g), Calcium (82.1mg), Iron (5.1mg), Vitamin A (366.2µg), Thiamin (0.2mg), Riboflavin (0.1mg), Ascorbic acid (16.5mg), Niacin (1.4mg), Energy (231 Calories).

2. ***BAMBARA KOOSE***

Ingredients: Bambara, Cooking oil, Pepper, Thyme, Shallots/Onion, Salt, Black Pepper and Ginger

Method: Clean, break and dehull bambara, mill into flour. Clean onion and other spices and grind into paste. Mix bambara flour with a little water and beat until dough is light and fluffy. Add spices to bambara paste and mix thoroughly, put oil in a saucepan and allow to heat. Drop small balls of the paste into oil and fry until golden brown. Remove and drain off the oil and serve hot or cold with porridge

Nutritional quality (per 100g): Protein (13.0g), Fat (4.6g), Carbohydrates (46.7g), Calcium (62.0mg), Iron (5.7mg), Vitamin A (7.3µg), Thiamin (0.2mg), Riboflavin (0.1mg), Ascorbic acid (3.0mg), Niacin (1.6mg), Energy (280.4 Calories).

3. BAMBARA MANGUOLO

Ingredients: Bambara, Cooking oil, Pepper, Onion, Salt, and Pepper

Method: Clean, soak, dehull and dry bambara. Mill into flour and mix into paste. Beat until fluffy and add ground onions, pepper and salt to taste. Drop small balls of the paste into oil and fry until golden brown. Serve hot.

Nutritional quality (per 100g): Protein (14.1g), Fat (5.1g), Carbohydrates (50.0g), Calcium (62.7mg), Iron (6.2mg), Vitamin A (3.4µg), Thiamin (0.1mg), Riboflavin (0.1mg), Ascorbic acid (1.4mg), Niacin (1.7mg), Energy (301.5 Calories).

4. BAMBARA SAWALA

Ingredients: Bambara, Cooking oil, Salt petre and Salt

Method: Mill bambara into flour and mix with water to form a thick mixture. Add a little potash and salt to taste. Heat oil in a sauce-pan and fry tiny balls till golden brown. Allow to cool and serve with stew, boiled rice or pound and add to soups.

Nutritional quality (per 100g): Protein (17.7g), Fat (6.4g), Carbohydrates (61.8g), Calcium (74.1mg), Iron (7.8mg), Vitamin A (trace), Thiamin (0.3mg), Riboflavin (0.1mg), Ascorbic acid (trace), Niacin (2.1mg), Energy (374 Calories).

5. BAMBARA GABLEE

Ingredients: Bambara flour, Kokonte (optional), Onion, Groundnut oil or shea-butter, Salt petre (ground), Sesame seed (powdered), Pepper, Water, Salt, Leaves or sponge for steaming

Method: Put water on fire to heat slowly. Sieve bambara flour into a mixing bowl, add a little water and beat batter till fluffy. Add konkonte (optional) and salt petre and mix well. Add enough water and mix into batter. Put on fire and when water begins to boil, wash sponge or leaves and put in pot or saucepan to form

a bed for the gablee. Fetch half hand-full of batter and arrange over steamer on leaves or sponge. Allow water to boil over first layer, arrange second layer over the first allowing water to boil over before another layer is added till the batter is finished. Cover and cook for 30 min. Mix pounded sesame seed, pepper and salt. Chop onions and fry in oil till brown. Serve gablee in dishes, sprinkle spices over, then followed by oil and onion or serve with gravy.

Nutritional quality (per 100g): Protein (11.9g), Fat (4.2g), Carbohydrates (55.2g), Calcium (61.6mg), Iron (5.8mg), Vitamin A (2.8µg), Thiamin (0.2mg), Riboflavin (0.1mg), Ascorbic acid (1.2mg), Niacin (1.5mg), Energy (305 Calories).

6. BAMBARA TUBANI

Ingredients: Bambara flour, Kokonte (optional), Onion, Groundnut oil or shea-butter, Salt petre (ground), Sesame seed (powdered), Pepper, Water, Salt, Leaves for steaming & wrapping

Method: Put water on fire to heat slowly. Sieve bambara flour into a mixing bowl, add a little water and beat until light and fluffy. Add konkonte (optional) and salt petre and mix well. Add enough water and mix into batter. Fetch handfuls or spoonfuls and wrap in leaves and steam for 30 minutes. Cut tubani to desirable pieces and serve just like gablee

Nutritional quality (per 100g): Protein (11.9g), Fat (4.2g), Carbohydrates (55.2g), Calcium (61.6mg), Iron (5.8mg), Vitamin A (2.8µg), Thiamin (0.2mg), Riboflavin (0.1mg), Ascorbic acid (1.2mg), Niacin (1.5mg), Energy (306 Calories).

7. BAMBARA BENTINTAARI/TENDAR

Ingredients: Bambara flour, Kokonte (optional), Onion, Groundnut oil or shea-butter, Salt petre (ground), Sesame seed (powdered), Pepper, Water, Salt, Leaves or sponge for steaming

Method: Put water on fire to heat slowly. Sieve bambara flour into a mixing bowl, add a little water and beat until light and fluffy. Add konkonte (optional) and salt petre and mix well. Add salt petre and mix. Add enough water and mix into batter. Smear paste on a pot and steam for 10 – 15 minutes. Serve by sprinkling spices and oil or serve with gravy

Nutritional quality (per 100g): Protein (11.9g), Fat (4.2g), Carbohydrates (55.2g), Calcium (61.6mg), Iron (5.8mg), Vitamin A (2.8µg), Thiamin (0.2mg), Riboflavin (0.1mg), Ascorbic acid (1.2mg), Niacin (1.5mg), Energy (306 Calories).

8. BAMBARA BENN SAWELE

Ingredients: Bambara flour, Roasted corn meal, Bean leaves (powdered), Kanwe (salt petre), Onion, Pepper, Salt

Method: Wash and pound bean leaves with kanwe (salt petre). Mix roasted corn meal and bambara flour with pounded leaves. Add a little water, form balls and steam. Season oil with onion, and pound salt and pepper together. Break steamed balls; add seasoned oil, pepper and salt. Mix well and serve hot.

Nutritional quality (per 100g): Protein (6.1g), Fat (1.7g), Carbohydrates (26.4g), Calcium (84.4mg), Iron (3.7mg), Vitamin A (725µg), Thiamin (0.1mg), Riboflavin (0.1mg), Ascorbic acid (31.8mg), Niacin (1.1mg), Energy (145 Calories).

9. BAMBARA WEANIMIX

Ingredients: Bambara, Groundnut and Corn

Method: Roast bambara, groundnuts and corn separately. Dehull roasted groundnut and bambara, mix with roasted corn and mill into flour. Add bambara flour, and mix well to obtain bambara weanimix. This is used for the preparation of traditional breakfast porridges

Nutritional quality (per 100g): Protein (13.2g), Fat (11.2g), Carbohydrates (63.8g), Calcium (27.1mg), Iron (33.8mg), Vitamin A (trace), Thiamin (0.1mg), Riboflavin (0.1mg), Ascorbic acid (7.1mg), Niacin (1.8mg), Energy (420 Calories).

10. BAMBARA WEANIMIX PORRIDGE

Ingredients: Bambara weanimix, Salt and Sugar

Method: Mix bambara weanimix with water, add salt and bring to boil while stirring continuously to avoid formation of lumps. Allow to boil at low heat for 10 – 15 minutes. Add sugar to taste and serve

Nutritional quality (per 100g): Protein (2.1g), Fat (1.8g), Carbohydrates (10.2g), Calcium (4.3g), Iron (5.4mg), Vitamin A (trace), Thiamin (0.02mg), Riboflavin (0.02mg), Ascorbic acid (1.1mg), Niacin (0.3mg), Energy (67 Calories).

11. SPICED BAMBARA WEANIMIX PORRIDGE

Ingredients: Bambara weanimix, Pepper (ground), Ginger (ground) and Sugar

Method: Mix bambara weanimix with water and bring to boil. Mix ground pepper and ginger together and strain well. Add strained spices to porridge and mix well. Allow to boil at low heat for 10 – 15 minutes. Add sugar to taste and serve.

Nutritional quality (per 100g): Protein (2.1g), Fat (1.8g), Carbohydrates (10.2g), Calcium (4.3mg), Iron (5.4mg), Vitamin A (trace), Thiamin (0.02mg), Riboflavin (0.02mg), Ascorbic acid (1.1mg), Niacin (0.3mg), Energy (67 Calories).

TRAINING SESSION III:

PRODUCTION AND UTILIZATION OF HIGH QUALITY BAMBARA FLOUR (HQBF)

By W.A. Plahar, Food Research Institute, Accra, and Mercy Falley, MoFA-WIAD

The Extension Brochures

The high quality bambara flour production technology was re-packaged for both commercial production and for household preparation, and a total of four extension brochures for training of trainers were developed and produced in English and the local language, Dagbani. These brochures were introduced to participants at the training sessions. The step-by-step procedures were studied until participants became conversant with both the processing technologies involved and the mode of presentation in the field. The text contents of the brochures are reproduced below.

a. Brochure #1

COMMERCIAL PRODUCTION OF HIGH QUALITY BAMBARA FLOUR

A STEP-BY-STEP PROCEDURE

Process

- Wash and soak 3 maxi (300 kg) bags of bambara beans for one hour
- Boil for 30 minutes using gas fired stove
- Drain and spread on trays in Cabinet Hot Air Dryer maintained at 60 –70°C to dry
- Break loosely in Corn Mill to remove seed coat
- Winnow to separate seed coat
- Mill into flour
- Allow to cool and package in polyethylene bags (0.5 kg or 1.0 kg)
- Label and seal with a Heat Sealing Machine
- Pack and store HIGH QUALITY BAMBARA FLOUR for distribution and sale

QUALITY ATTRIBUTES OF HIGH QUALITY BAMBARA FLOUR HIGH QUALITY BAMBARA FLOUR

- ***Sweet aroma, No bitter aftertaste***
- ***No flatulence or stomach bloating effect***
- ***Suitable for diversified food uses.***

- ***Cooking time for foods prepared with the HQBF is drastically reduced***
- ***No varietal differences in its suitability for traditional food uses***
- ***Gives more yield for traditional foods***
- ***Has high whipping properties.***

NUTRITION INFORMATION

The High Quality Bambara Flour is a complete food nutritionally. It has:

6 % Moisture
21 % Protein
8 % Fat
61 % Carbohydrates.

USES

Traditional foods such as Akla and Tubani. Also used in recipes and other formulations including weaning foods, cookies, cakes, doughnut, bread etc.

b. Brochure #2 (Dagbani)

SINKPULI ZIM SUƆ, Daabiligu Pam Niŋbu Soli,

Yim-yim soli din soŋ-di Wuhiriba

NIƆBU SOLI

Pag'mi Sinkpula kpalans'ata (bee kurga kobga) vien-yelinga ka lohi-li kom-ni ka di paai hawa yini.

Kpaai-mi li niŋ kom din-kpieri ni, ka waaimi-li ka di paai minti pishi (minti 20) ni bugum din diri vien-yelinga.

Yaa-mi Sinkpuli waara maa, n-zaŋ-li niŋ Pohim Tulli Kuura maani. Cheli ka di tulim maa kul hila digrii 60-70oC hal'ka di ti kuui-gi kahi-kahi.

Wurgim-li Zim Maneeka maa ni n-yihi di pag-tahi maa zaa.

Yeli mi di zaa, n-yihi di pag-tahi maa zaa.

Niem-mi di zaa vien-yelinga.

Che ka zim-maa maai vien-yelinga ka'a naain-yi su-li luba-baagi nim ni, kaman kilo prigli-prigli, bee kilo yini-yini.

Tablim takari bihila, ka zaŋ Tulim Mazhini maa n-kpabsi luba-baagi nim maa noya.

Zaŋmi Sinkpuli Zim Suŋ (SZS) maa n-zaŋ kohi bee n-tahi kohimma.

SINKPULI ZIM SUƆ DAABILIGU PAM NIƆBU SOLI

Nyom suŋ. Di bi to naga-naga

Di bi tiri binfaam bee n-fahiri puli

Di tooi niŋdi bindiri balibu pam.

Sinkpuli Zim Suŋ (SZS) bindira bi dug'ri yuui-ra.

Di nabri bindirigu dug'bu ni

Di duri vien-yelinga pam.

BINDIRIGU BALBU LAHABALI

Sinkpuli Zim Suŋ (SZS) nyela bindir'sheli din bi pooi Daadam Ningbung ni bori sheli, di mal'la:

Komdin be dini 6%

Din meeri Ningbung: 21%.

Kpam: 8%

Di tiri Tuma-yaa: 61%

BINDIRIGU BUKAATA

Sinkpuli Zim Suŋ ŋo niŋdi Yama, ni Tuubaani, Zim-dirili, Koose, Paanu, Maha, bofroto, ni bindira balibu pam.

c. Brochure #3

HOUSEHOLD PREPARATION OF HIGH QUALITY BAMBARA FLOUR

EXTENSION MANUAL FOR TRAINERS

PROCESS

Wash and soak 2 American tins (4 kg) of bambara beans for one hour

Boil for 20 minutes using traditional cooking methods

Drain and spread on a platform to dry in the sun

Break loosely in local Corn Mill or by pounding with mortar & pestle

Winnow to separate seed coat

Mill into flour. Allow to cool and pack in closed containers. Store high quality bambara flour for household use

QUALITY ATTRIBUTES OF HIGH QUALITY BAMBARA FLOUR

Sweet aroma, No bitter aftertaste

No flatulence or stomach bloating effect

Suitable for diversified food uses.

Cooking time for foods prepared with the HQBF is drastically reduced

Gives more yield for traditional foods

Has high whipping properties.

NUTRITION INFORMATION

The High Quality Bambara Flour is a complete food nutritionally. It has:

6-10 % Moisture

21 % Protein

8 % Fat

61 % Carbohydrates.

USES

Traditional foods such as Akla and Tubani. Also used in recipes and other formulations including weaning foods, cookies, cakes, doughnut, bread etc

d. Brochure #4

Yiŋ Sinkpuli Zim Suŋ

Niŋbu Soli

WUHIRIBA GBAƆ WUHIRILI

NIƆBU SOLI

Pag'mi Sinkpula kurga'ayi vien-yelinga ka lohili kom-ni ka di paai hawa yini.

Kpaai-mi li niŋ kom din-kpieri ni, ka waai mi li ka di paa minti pishi (minti 20) daaŋ-ga ni bee kur'pootu zugu.

Yaa-mi Sinkpuli waara maa, n-yarigi-li dun'doŋ'vielli-ni ka che ka wuntaŋ kuui-li vien-yelinga.

Wurgim-li Zim Maneeka ni bee n-sor' li toli ni.

Yeli mi di zaa, n-yihi di pag-tahi maa zaa kahi-kahi.

Niem-mi di zaa vien-yelinga ka di lee zim balli.

Che ka zim-maa maai vien-yelinga ka' a naain-yi zaŋ-li niŋ dug-ri bee taha din mali linsi puuni.

Zaŋmi Sinkpuli Zim Suŋ (SZS) maa n-zali n-dug'ri tiri a yiŋ-nima.

SINKPULI ZIM SUƆ (SZS) YELI-SUMA DIM-MALI ANFAANI PAM YELA.

Nyom suŋ. Di bi to naga-naga

Di bi tiri binfaam bee n-fahiri puli

Di tooi niŋdi bindiri balibu pam.

Sinkpuli Zim Suŋ (SZS) bindira bi dug'ri yuui-ra.

Di nabri bindirigu dug'bu ni

Di duri vien-yelinga pam.

BINDIRIGU BALBU LAHABALI

Sinkpuli Zim Suŋ (SZS) nyela bindir'sheli din bi pooi Daadam Ningbung ni bori sheli, di mal'la:

komdin be dini 6%-10%

Din meeri Ningbung: 21%.

Kpam: 8%

Di tiri Tuma-yaa: 61%

BINDIRIGU BUKAATA

Sinkpuli Zim Suŋ ŋo niŋdi Yama, ni Tuubaani, Zim-dirili, Koose, Paanu, Maha, bofroto, ni bindira balibu pam.

Practical Work

Based on the procedures outlined in the brochures, participants went through the process and produced High Quality Bambara Flour samples, which they compared with the traditional flour to appreciate the obvious differences in the physical and organoleptic characteristics. The flour was used to prepare traditional foods suct as koose and tubani. Some of these activities are captured in the pictures below.

Fig 1. Participants being shown the branching process

Fig 2. Sun-drying branched bambara drying (cement floor)

Fig 3. Sun-drying branched bambara (raised platform)

Fig 4. Participants examining bambara flour samples produced

Fig 5. Preparation of batter for akla and tubaani

Fig.6. Participants preparing tubaani

Fig 7a. Frying Akla

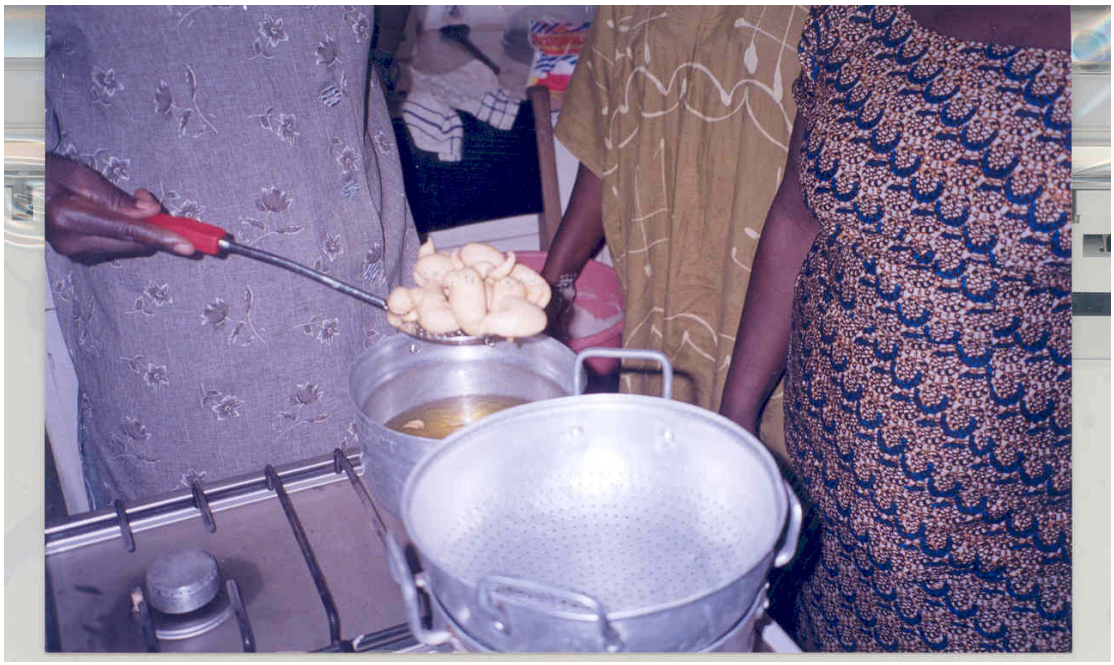

Fig 7b. Frying Akla

Fig 8. Samples of Tubaani (left) and Akla (right) prepared by participants

CLOSING REMARKS

In his closing remarks, the project leader, Dr. Plahar expressed satisfaction at the enthusiasm and the zeal with which participants went about the training programme. He was very confident that the extension staff would disseminate the knowledge acquired in all the communities within their operational districts. He thanked all the resource persons for a good job done, and wished all a safe journey back to their stations.