FOOD RESEARCH INSTITUTE
NARP MAIZE PROGRAMME

PROCESS CHARACTERISTICS AND QUALITY EVALUATION OF RELEASED MAIZE VARIETIES

BY

J.T. MANFUL , A. OSEI-YAW (MRS) AND M. HODARI-OKAE (MRS)

INTRODUCTION:

Maize (Zea mays), a major staple food crop in many developing countries, including Ghana, provides about 90% of the total calories in the diets of people in the southern sector of Ghana (national Food and Nutrition Board, 1962). In Ghana, the high cost of inputs for maize cultivation coupled with the low yield has made the local maize variety expensive and uncompetitive on the export market (Ashiama, 1986). Efforts in the West African sub-region have involved variety improvement research to obtain high-yielding varieties for cultivation by local farmers.

The success of breeder improvement programmes depends not only on high production yields and desirable agronomic characteristics but also on the suitability of the varieties for food uses. Consumer acceptability of any improved varieties will depend on desirable functional and sensory properties for the traditional maize food. In Ghana, consumer complaints concerning improved varieties have included hard grain texture, difficulty in milling (dry or soaked), chaffy meal with low swelling capacity and poor sensory characteristics of the prepared maize dishes (Sallah and Dzah, 1986).

Work on maize variety improvement has remained a steady activity of maize breeders and researchers and the need exists to establish and characterize the properties of released varieties and determine their suitability for specific food use. This will help breeders and extension workers to concentrate on the promotion of high yielding varieties with desirable food properties.

This work therefore aims to

1. Characterize the quality of released maize varieties in terms of their physical, chemical, microbiological, functional, nutritional and anti-nutritional properties.

2. Evaluate released varieties of maize for their processing characteristics and specific food uses.

METHODOLOGY:

Eight varieties of maize namely, GH 110-5, Obatanpa, GH 132-28, GH 2328-88, Abeleehi, NAES EE W SR, Dorke and a local check variety were evaluated for their rheological and sensory characteristics.

The rheological characteristics were determined by milling the maize grains whole in a laboratory attrition mill. An 8% suspension of flour was made and heated in a Brabender Viscoamylograph to 95°C and held at that temperature for 20 minutes. The resultant paste was then cooled to 50°C. The speed of rotation was 75rpm and a 500cmg sensitivity cartridge was used.

The viscosity of the paste was recorded by the instrument through the heating and cooling processes.

Other derived characteristics were also computed from the instrument readings.

The parameters recorded and computed were as follows:

Pasting Temperature - (the temperature of initial gelatinisation on the instrument) - 3°C

Peak Viscosity	(P)	- the highest viscosity during heating.
Hot paste viscosity	(H)	- the viscosity after holding at 95°C for 20 min.
Cold Paste viscosity	(C)	- the viscosity after cooling to 50°C.
Breakdown	(BD)	- (P-H)
Breakdown ratio		- (H/P)
Relative breakdown	(BDr)	- (P-H) / (C-H)
Setback	(SB)	- (C-P)
Total setback	(SBt)	- (C-H)
Setback ratio		- (C/P)
Total setback ratio		- (C/H)

Two common traditional maize foods, "koko", a thin porridge and "kenkey", a thick porridge were prepared and used to evaluate consumer preference for the maize varieties.

Sensory preferences for aroma, taste, texture and overall acceptability were recorded on a 9-point hedonic scale (1 = dislike extremely and 9 = like extremely).

RESULTS AND DISCUSSION:

Table 1 shows the pasting characteristics of the 8 varieties of maize.

The pasting temperatures ranged from 80.5°C for GH 2328-88 to 88.2°C for Dorke S.R. Generally peak viscosities measure the ability of starches to form pastes during cooking. Starches with high peak viscosities form thick pastes on cooking. The peak viscosities for the maize varieties were low with Obatanpa having the highest peak viscosity of 450 Brabender Units (BU) whilst the local check variety had a peak viscosity of 310 BU.

The hot paste viscosity is the viscosity of the paste after holding at 95°C for 20 min. The breakdown of the paste is the difference between the peak viscosity and the hot paste viscosity and is a measure of the stability of the paste after cooking at 95°C (Table 2).

Obatanpa had the highest breakdown value of 290BU meaning that it had the least stable starch among the varieties followed by Dorke SR with a value of 277BU. The paste of the local variety had the least breakdown value of 180BU indicating that it was the most stable. GH 132-28 with a breakdown value of 185BU was comparable to the local variety.

The cold paste viscosity is the paste viscosity after cooling to 50°C. The difference between this and the peak viscosity and the hot paste viscosity are the setback and total setback respectively. These two indices are measure of starch retrogradation (Bhattacharya and Sowbhagya, 1979). Total setback and setback values also have high positive correlations with the amylose content of the grain. Dorke SR had the highest total setback value of 262BU indicating that it would have the most floury endosperm while the local variety had the least value of 140BU. The points to a vitreous endosperm for the local variety (Table 2).

Table 3 shows the sensory characteristics of kenkey made from the varieties. Trained panelists ranked the various characteristics on a 9 point Hedonic scale of 1 (least preferred) to 9 (most preferred). NAES EE W SR and Dorke S.R. had the best physical appearances of 7.45 and 7.54 respectively. GH 132-28 was least attractive with a scoring of 3.80. On the overall acceptability of the varieties for kenkey, GH 2328-88 has adjudged the best with a scoring of 7.20 followed by NAES EE W SR with a scoring of 6.81. Obatanpa and GH 132-28 were found to be the least preferred for kenkey with a scoring of 5.00.

The sensory characteristics of the varieties with respect to porridge (koko) quality are shown in Table 4. NAES EE W SR had the best flavour with an 8.00 scoring. GH 2328-88 was found to have the overall best acceptability for porridge making with a scoring of 7.80 followed by Obatanpa with 7.50. Abeleehi was least preferred with a scoring of 5.18. This was as a result of the fact that the flavour was adjudged to be undesirable y the panelist.

Table 5 shows the physical characteristics of the varieties. All the varieties had white endosperms. The grains were very clean with a complete absence of insects. However, the 1000-grain weight which is an indication of the grain size showed some variability. Obatanpa had the highest 1000-grain weight of 320.8 grams followed by Dorke SR with 307.1 grams. The local check variety had the smallest grain size with a 1000-grain weight of 205.1 grams.

Table 6 shows the results of microbiological analyses carried out on the samples.
Analyses carried out were total aerobic bacteria count, mould and yeast count, pH, culture identification, coliforms, faecal coli and lactic acid bacteria enumeration.

Quantitative bacteria analysis showed low levels ranging from 1.4×10^2 to 7.4×10^2 bacteria organisms/g of sample. For the mould and yeast count/g of sample, values ranged from 3.0×10^1 and 6.3×10^3 cfu/g. The dominant bacteria organisms isolated in all maize samples were Gram positive Bacillus sp. However Micrococci were isolated from GH 2328-88. Mould organisms that persisted in all the eight samples were Aspergillus niger. However, four of the samples found to be more infested with mould organisms were Obatanpa, GH 132-28, Abeleehi and the Local variety.

In addition, A. flavus was isolated from four samples namely Obatanpa, Abeleehi Dorke SR and Local. Mucor sp. was also isolated from GH 110-5,GH 132-88 and Local.

The pH values for the maize ranged between 5.10 and 5.70.
Coliform organizms and faecal coli as well as lactic acid bacteria were not isolated from all of the eight samples. The absence of faecal coli organizms indicated that the maize samples have been handled hygienically and free any faecal matter.

CONCLUSION

The grains were of high microbiological and physical quality with a wide variation in grain size. GH 2328-88 was found to be the most desirable cultivar for both kenkey and thin porridge preparation. Whilst Obatanpa and GH 132-28 were the least preferred for kenkey, abeleehi was the least desirable variety for porridge preparation.

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Table 1: Pasting Characteristics of some Maize Varieties

Variety	Pasting Temperature (°C)	Peak Viscosity (BU) [P]	Hot Paste Viscosity (BU) [H]	Cold Paste Viscosity (BU) [C]
GH 110-5	86.0	400	160	380
Obatanpa	81.1	450	160	340
GH 132-28	81.1	325	140	300
GH 2328-88	80.5	360	160	330
Abeleehi	85.9	360	140	340
NAES EE W SR	86.9	420	190	360
Dorke SR	88.2	435	158	420
Local	82.5	310	130	270

Table 2: Viscoamylographic Indices of some Maize Varieties

Variety	Breakdown (P-H) [BU]	Breakdown Ratio (H/P)	Relative Breakdown (H-P)/(C-H)	Setback (C-P) [BU]	Total Setback (C-H) [BU]	Setback Ratio (C/P)	Total Setback Ratio (C/H)
GH 110-5	240	0.40	1.09	-20	220	0.95	2.37
Obatanpa	290	0.35	1.61	-110	180	0.75	2.12
GH 132-28	185	0.43	1.15	-25	160	0.92	2.14
GH 2328-88	200	0.44	1.17	-30	170	0.92	2.06
Abeleehi	220	0.39	1.10	-20	200	0.94	2.43
NAES EE W SR	230	0.45	1.35	-60	170	0.86	1.89
Dorke SR	277	0.36	1.06	-15	262	0.96	2.66
Local	180	0.42	1.28	-40	140	0.87	2.08

Table 3: Sensory Characteristics scores* of some Maize Varieties (Kenkey)

Variety	Appearance	Odour	Taste	Sourness	Finger feel	Mouth feel	Overall Acceptability
GH 110-5	6.50	6.40	6.80	6.10	7.10	6.40	6.30
Obatanpa	6.20	5.00	5.20	5.60	4.80	4.80	5.00
GH 132-28	3.80	4.70	5.50	5.30	5.40	5.50	5.00
GH 2328-88	7.30	7.10	7.30	7.40	7.10	6.70	7.20
Abeleehi	6.90	4.63	5.54	5.54	6.00	6.00	5.27
NAES EE W SR	7.45	7.18	6.90	7.00	7.09	6.63	6.81
Dorke SR	7.54	7.27	6.09	5.81	6.27	5.90	6.09
Local	7.18	6.63	5.72	6.27	6.63	6.63	5.90

*Scale of 9 to 1; where 9 = like extremely and 1 = dislike extremely.

Table 4: Sensory Characteristics scores* of some Maize Varieties (Koko)

Variety	Appearance	Odour	Taste	Sourness	Mouth feel	Overall Acceptability
GH 110-5	5.60	6.40	6.50	6.20	6.50	6.40
Obatanpa	7.80	7.60	7.50	7.50	7.30	7.50
GH 132-28	5.00	6.40	6.20	6.30	7.20	6.20
GH 2328-88	7.80	7.70	7.80	7.70	7.60	7.80
Abeleehi	7.18	3.72	5.00	5.27	5.54	5.18
NAES EE W SR	7.90	8.00	7.18	7.09	7.45	7.45
Dorke SR	6.63	6.54	5.81	5.54	6.45	5.90
Local	7.45	7.27	6.63	6.72	6.81	6.63

*Scale of 9 to 1; where 9 = like extremely and 1 = dislike extremely.

Table 5: Physical Characteristics of Maize Varieties

Variety	Endosperm Colour	1000 Grain Weight (g)	Insects
GH 110-5	White	290.5	Absent
Obatanpa	White	320.8	Absent
GH 132-28	White	278.4	Absent
GH 2328-88	White	272.8	Absent
Abeleehi	White	259.7	Absent
NAES EE W SR	White	272.7	Absent
Dorke SR	White	307.1	Absent
Local	White	205.1	Absent

Table 5: Microbiological Examination of Maize Varieties

Variety	Total viable Count/g Aerobic	Mould & Yeast Count/g	pH	Culture	Coliform	Faecal Coli	Lactic Acid Bacteria
GH 110-5	3.8×10^2	9.0×10^1	5.25	Gm+ve sporing Bacillus, Mucor, A. Niger	Not found in 0.1g	Not found	Absent
Obatanpa	4.8×10^2	108×10^3	5.12	Gm+ve sporing Bacillus, A. Niger Penicillium	Not found in 0.1g	Not found	Absent
GH 132-28	4.5×10^2	1.5×10^3	5.30	Gm+ve sporing Bacillus, Mucor, A. Niger	Not found in 0.1g	Not found	Absent
GH 2328-88	3.1×10^2	3.0×10^1	5.10	Gm+ve sporing Bacillus, Micrococci, A. Flavus, A. Niger	Not found in 0.1g	Not found	Absent
Abeleehi	4.2×10^2	6.3×10^3	5.30	Gm+ve sporing Bacillus, A. Niger, Penicillium	Not found in 0.1g	Not found	Absent
NAES EE W SR	3.5×10^2	1.2×10^2	5.62	Gm+ve sporing Bacillus, A. Flavus, A. Niger	Not found in 0.1g	Not found	Absent
Dorke S.R	1.4×10^2	1.0×10^2	5.60	Gm+ve sporing Bacillus, A. Niger, Penicillium	Not found in 0.1g	Not found	Absent
Local	7.4×10^2	1.2×10^3	5.70	Gm+ve sporing Bacillus, Mucor, A. Niger, Penicillium	Not found in 0.1g	Not found	Absent