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CONSUMPTION AND ACCEPTABILITY PATTERN OF 21 EVALUATED MAIZE HYBRIDS FOR FRESH MAIZE PRODUCTION IN SOUTH-EASTERN NIGERIA

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Abstract

Purpose: Green (fresh) maize (*Zea mays L.)* provides food security and income to farmers especially when other crops are still in the field. However, research on green maize variety is scarcely reported in literature or information on the consumption or acceptability pattern of the developed maize hybrids. Unattractive colour, bad taste, kernel size and hard kernels are among factors that affect the level of fresh maize acceptability and subsequent consumption of genotypes in the South eastern part of Nigeria, therefore, the purpose of this work is to study the variation in sensory characteristics of hybrids generated from crosses between seven maize genotypes of two local varieties (Oka Mbaise and Oka Bende-white) and five improved varieties (DTMA-4, DMR-ESRY (POOL 18-SR), PVA SYM 8 F2 (PRO VIT A), POOL 66/ACR-91 SUWAN – 1- SR (QPM), DTMA – W, from IITA) was evaluated at the Centre for Agricultural Research, Federal University of technology Owerri and the sensory evaluation was done at different hostels in Umuchima, Ihiagwa and Centre for Agricultural Research, FUTO.

Methodology: The methodology used in the field to develop these hybrids was the Randomized Complete Block Design (RCBD). Questionnaires were used to achieve the following palatability qualities measured; colour, kernel hardness, appeal, size and taste. The numerical scoring from the questionnaires was analysed using Genstat discovery 10th Edition.

Results: The result of this work revealed that there were significant differences among the hybrids for kernel size and appeal. The cross between DTMA-4 and all other genotypes had the highest grain size (2.17) and was the most preferred by the respondents. The crosses between POOL 66/ACR-91 SUWAN – 1- SR (QPM) and Oka Mbaise; POOL 66/ACR-91 SUWAN – 1- SR (QPM) and Oka Bende-white; DTMA – W and Oka Mbaise; DTMA – W and Oka Bende-white; Oka Mbaise and Oka Bende-white had the hardest grain (3.00) and were least preferred by the respondents. Correlation matrix of the sensory evaluation revealed that grain size, colour and appeal were positively correlated while hardness was negatively correlated with appeal.

Contribution to theory, policy and practice: In contribution to practice, the study recommend the cross OKA MBAISE X OKA BENDE-WHITE as it was highly preferred by the respondents.

Keyword: *sensory evaluation, fresh maize, acceptability, genotypes, variation, palatability test*.

INTRODUCTION

Green (fresh) maize (*Zea mays L.)* provides food security and income to farmers especially when other crops are still in the field. The ears are harvested during the milk stage when the grains are fully formed and not fully matured. This occurs about twenty (20) days following the appearance of the first silk strands (Kling, 1991).

The global estimate of fresh maize suggests that it is one of the five most profitable vegetable in the world (FAOSTAT, 2005). Wheat, rice and maize are the most important cereal crops in the

world but maize is the most popular due to its high yielding, ease of processing, readily digested and costs less than other cereals (Jaliya, Falaki, Mahmud and Sani 2008).

According to IITA (2001) report, maize contains 80 per cent carbohydrates, 10 percent protein, 3.5 percent fibre and 2 percent mineral. Iron and vitamin B are also present in maize. Green maize (fresh on the cob) is eaten parched, baked, roasted or boiled and plays important role in filling the hunger gap while other crops are yet to mature.

According to (FAOSTAT, 2005), the areas under vegetable maize production compared to two tops vegetable in Nigeria are 161, 000, 127,000 and 41,000 for vegetable maize, tomato and onions respectively.

The most important palatability attributes that affects acceptability and consumption pattern of maize genotypes are the grain size, appeal, colour, taste and hardness (Alika *et al.*, 1988).There are geographical preference for certain colour of green maize, however, the constraints to fresh maize consumption pattern include; bad taste, hard kernels and unattractive colour (FAOSTAT, 2003). Quality is one of the main criteria for desirability of any food or its product to consumers. Appearance (appeal, which can be judged by the eye example colour, shape, size, uniformity and absence of defects is of great importance in food selection (Obilana, 1982) while flavour embraces the senses of smell, feeling and taste.

As green maize fills the hunger gap while other crops are still in the field, the problem arises as to how to produce maize that is of high nutritional quality and in high quantity, there is a great prospect for enhancing consumption of fresh maize through selection, crossing and hybrid evaluation of maize genotypes that could accumulate these aforementioned palatability attributes, therefore, the need of this study.

Materials and Methods

The research was carried out at the Centre for Agricultural Research, School of Agriculture and Agricultural Technology of the Federal University of Technology Owerri, Imo State,(Lat. $5^0$27' N, Long. $7^0$02'E, mean temperature of 29^0 C; relative humidity of 89%; and an altitude of 50-70 cm above sea level) between July and November 2016.

Description of genotypes used for the study:

The material consisted of 28 genotypes, 7 of which were parents and the remaining 21 were crosses as shown in the table below;

Table 1: Evaluated Genotypes

S/N	ENTRIES	EXPERIMENTAL CODE	STATUS
1	DTMA-4	V1	PARENT
2	DMR-ESRY (POOL 18-SR)	V2	PARENT
3	PVA SYM 8 F2 (PRO VIT A)	V3	PARENT
4	POOL 66/ACR-91 SUWAN – 1- SR (QPM)	V4	PARENT
5	DTMA – W	V5	PARENT
6	Oka Mbaise	V6	PARENT
7	Oka Bende-white	V7	PARENT
8	DTMA-4 X DMR-ESRY (POOL 18-SR)	v1v2	HYBRID
9	DTMA-4 X PVA SYM 8 F2 (PRO VIT A)	v1v3	HYBRID
10	DTMA-4 X POOL 66/ACR-91 SUWAN – 1- SR (QPM)	v1v4	HYBRID

11	DTMA-4 X DTMA – W	v1v5	HYBRID
12	DTMA-4 X Oka Mbaise	v1v6	HYBRID
13	DTMA-4 Oka Bende-white	v1v7	HYBRID
14	DMR-ESRY (POOL 18-SR) X PVA SYM 8 F2 (PRO VIT A)	v2v3	HYBRID
15	DMR-ESRY (POOL 18-SR) X POOL 66/ACR-91 SUWAN – 1- SR (QPM)	v2v4	HYBRID
16	DMR-ESRY (POOL 18-SR) X DTMA – W	v2v5	HYBRID
17	DMR-ESRY (POOL 18-SR) X Oka Mbaise	v2v6	HYBRID
18	DMR-ESRY (POOL 18-SR) X Oka Bende-white	v2v7	HYBRID
19	PVA SYM 8 F2 (PRO VIT A) XPOOL 66/ACR-91 SUWAN – 1- SR (QPM)	v3v4	HYBRID
20	PVA SYM 8 F2 (PRO VIT A) X DTMA – W	v3v5	HYBRID
21	PVA SYM 8 F2 (PRO VIT A) X Oka Mbaise	v3v6	HYBRID
22	PVA SYM 8 F2 (PRO VIT A) X Oka Bende-white	v3v7	HYBRID
23	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X DTMA – W	v4v5	HYBRID
24	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X Oka Mbaise	v4v6	HYBRID
25	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X Oka Bende-white	v4v7	HYBRID
26	DTMA – W X Oka Mbaise	v5v6	HYBRID
27	DTMA – W X Oka Bende-white	v5v7	HYBRID
28	Oka Mbaise X Oka Bende-white	v6v7	HYBRID

Experimental Design:

The diallel was generated during the second maize planting season of August, 2015 at the Centre for Agricultural Research, School of Agriculture and Agricultural Technology Teaching and Research Farm of Federal University of Technology Owerri. Half-diallel mating method involving the parents and excluding the reciprocals (that is, 21 crosses) in the first filial was used for the study. NPK 15:15:15 was applied at equivalent rate of 300kg/ha two weeks after planting and also at tasseling. The field was also treated with furadan 3% granular formulation of carbofuran to minimize stem borer and termite attack.

The maize genotypes were planted on sandy clay loam. The experimental design was randomised complete block design with four replications. The genotypes were grown in three row plots. The experimental area measures 12 m x 12 m. The whole area was divided into four blocks with spacing of 1m between each block. Each block contains twenty eight treatments with an inter row spacing distance of 0.75 m and intra row spacing distance of 0.25 m with the row 3 m long. The maize genotypes were planted under rain-fed conditions. After harvesting, the seeds were dried to 15% moisture.

Palatability Test:

This was carried out on the day of harvest (Physiological maturity) at different hostels in Umuchima, Ihiagwa and Centre for Agricultural Research, School of Agriculture and Agricultural Technology in Federal University of Technology, Owerri. The objective was to identify the best maize genotype for fresh maize production in Southeastern Nigeria.

The Maize cobs were boiled for about one hour (1 hour) after which it was displayed on a table with each variety placed on a separate tray and tagged.

Printed questionnaires were distributed to the testers, where information concerning every genotype was filled after testing each of the boiled maize genotypes. Adequate drinking water was provided to enable the respondents rinse their mouth properly after testing each variety to

ensure the taste of one variety is not muddled with the taste of another. The bases for the test were colour, grain size, appeal, taste, hardness and preference which were rated with the following scales (Alika e*t al.,* 1988);

Colour:

White = 1

Yellow = 2

Mixed = 3

Grain size:

Large = 1

Medium = 2

Small = 3

Appeal:

Strongly =1

Mildly = 2

No = 3

Taste:

Sugary =1

Tasteless =2

Sour =3

Hardness:

Very soft =1

Soft = 2

Hard = 3

Very hard = 4

Preference:

Excellent = 1

Good = 2

Bad = 3

Questionnaire: This was prepared carefully for each test; the questionnaire was carefully typed and used as a guide to the sensory evaluation.

Data Analysis:

The results from questionnaires were collated and subjected to rank summation index (RSI) using Microsoft excel, 2007 version and Genstat Discovery 10th Edition. The best among the F1 generation were identified as fresh maize for consumption and production in Southeasten Nigeria.

RESULTS AND DISCUSSION

Sensory evaluation of the hybrids of the cultivars:

The results of sensory evaluation (palatability) of the crosses are presented in Table 2. The Table contains the respondent's evaluation of sample for colour, grain size, hardness, appeal, taste and preference. The scale rating detected that OKA MBAISE X OKA BENDE-WHITE, POOL 66/ACR-91 X OKA BENDE-WHITE and DTMA – W X OKA BENDE-WHITE were highly preferred while the rest of the crosses were moderately preferred in terms of colour, grain taste and grain size. The differences amongst these maize hybrids showed significant (P = 0.05) differences except for grain size and appeal.

Table 2: Panel evaluation of the F_1 progenies of the seven maize genotypes

F_1 hybrid	Colour	Grain size	Hardness	Appeal	Taste	Preference
v1v2	2.00	2.17	2.67	1.83	2.00	1.83
v1v3	2.00	2.17	2.67	1.83	2.00	1.83
v1v4	2.00	2.17	2.67	1.83	2.00	1.83
v1v5	2.00	2.17	2.67	1.83	2.00	1.83
v1v6	2.00	2.17	2.67	1.83	2.00	1.83
v1v7	2.00	2.17	2.67	1.83	2.00	1.83
v2v3	2.00	1.83	2.33	1.83	2.00	1.67
v2v4	2.00	1.83	2.33	1.83	2.00	1.67
v2v5	2.00	1.83	2.33	1.83	2.00	1.67
v2v6	2.00	1.83	2.33	1.83	2.00	1.67
v2v7	2.00	1.83	2.33	1.83	2.00	1.67
v3v4	2.00	1.83	2.17	1.83	1.00	2.00
v3v5	2.00	1.83	2.17	1.83	1.00	2.00
v3v6	2.00	1.83	2.17	1.83	1.00	2.00
v3v7	2.00	1.83	2.17	1.83	1.00	2.00
v4v5	2.00	1.83	2.17	1.83	1.00	2.00
v4v6	1.67	1.00	3.00	1.33	1.33	1.67
v4v7	1.67	1.00	3.00	1.33	1.33	1.67
v5v6	1.67	1.00	3.00	1.33	1.33	1.67
v5v7	1.67	1.00	3.00	1.33	1.33	1.67
v6v7	1.67	1.00	3.00	1.33	1.33	1.67
Grand mean	1.92	1.73	2.55	1.71	1.60	1.79
CV %	40.60	47.40	36.00	24.50	44.10	44.10
$LSD_{(0.05)}$	0.93	0.33	0.55	0.36	0.71	0.89

1. Scale rating 1 to 3 with 1 = white, 2 = yellow, 3= bi-colour (mixed).
2. Scale rating 1 to 3 with 1 = large, 2 = medium, 3 = small grain size.
3. Scale rating 1 to 4 with 1 = very soft, 2 = soft, 3 = hard, 4 = very hard
4. Scale rating 1 to 3 with 1 = strong appeal, 2 = mild appeal, 3 = not appealing
5. Scale rating 1 to 3 with 1 = sugary, 2 = tasteless, 3 = sour
6. Scale rating 1 to 3 with 1 = highly preferred (acceptable), 2 = moderately acceptable, 3 = unacceptable (rejected)

Interrelations among the palatability attributes of the maize hybrids.

The Pearson correlation matrix of the sensory evaluation and their linear coefficient (r) among the qualities are presented in Table 3. High significant (P = 0.01) and positive correlation were found between colour and grain size (r = 0.95**) and appeal (r = 1.00**), colour and preference were significantly (0.05) correlated (r = 0.51*) but had negative high significant correlation with hardness (r = - 0.81**). Grain size had high significant and positive correlation with appeal (r =

0.95**) but had significant (P = 0.05) positive correlation with taste (0.50*) and preference (0.50*). Hardness was found to be negatively correlated to appeal (r = - 0.81**) and preference (r = - 0.55**). Appeal had positive significant correlation with preference (r = 0.53*) while taste had negative correlation with preference (r = -0.50*).

Table 3. Pearson Correlation matrix of Palatability Qualities of Maize Hybrids

	Colour	grain size	hardness	Appeal	Taste	Preference
Colour						
grain size	0.95**					
Hardness	-0.81**	-0.58				
Appeal	1.00**	0.95**	-0.81**			
Taste	0.35	0.49*	0.14	0.35		
Preference	0.51*	0.50*	-0.58*	0.53	-0.50*	

***** = Correlation is significant (P=0.05), ** = Correlation is highly significant (P=0.01)

Green maize is mainly used for fresh maize consumption; several physical characteristics and chemical composition of fresh maize genotypes are required for acceptability or rejection of developed maize for consumption (Ngwuta *et al.,* 2001).

A fresh maize genotype must be superior in quality and must have special characteristics (soft, attractive, nutritious, sweet etc.) before it would be acceptable to consumers. The emphasis on palatable value of fresh maize has increased in recent years as a result of greater concern for the nutritional needs of people who obtain the major portion of their diet from fresh maize and to identify good palatable quality genotype(s).

The quality characteristics of a variety of fresh maize are complex, this require a long series of testing procedures which evaluate many different quality components of each genotype sample. The best quality potential, which may still be subjected to more thorough quality testing procedures after their superior characteristics have been established.

However, the genotypes evaluated portrayed some degree of diversity in terms of palatable qualities that are generally accepted by the respondents.

There is a positive and significant relationship between colour, grain size and taste. Conversely, negative correlation was recorded between preference and hardness.

Although in this study, little is known about the characteristics of the kernel associated with desirable taste, but generally, yellow fresh maize (a good source of vitamin A), with large grain, soft grain, good appeal and good taste was highly preferred by respondents sampled. This is in agreement with earlier findings by Onyishi and Obi (1990) that reported that there is a direct relationship between vitamin A (carotene in fresh maize) and acceptability.

CONCLUSION

Palatability test allow consumer and breeders to select genotypes with the best quality. This may still be subjected to more vigorous quality testing procedures after their superior agronomic characteristics have been demonstrated. The evaluated hybrids have some degree of variation in terms of the aforementioned palatability qualities. OKA MBAISE X OKA BENDE-WHITE,

POOL 66/ACR-91 X OKA BENDE-WHITE and DTMA – W X OKA BENDE-WHITE, these maize hybrids identified with fresh, good and palatable qualities and should be subjected to further improvement programme or introgressed into other breeding population. The hybrids produced as a result of the cross between OKA MBAISE X OKA BENDE-WHITE were highly preferred by the respondents of this study and is therefore recommended for production and consumption of fresh maize in the South-eastern Nigeria.

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