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Survey of Nigerian Local Maize for Protein Content

Untersuchung von lokalen nigerianischen Maissorten auf Proteingehalt

by I. U. Obi[1], O. A. Oluro[2], B. N. Okwuosa[3] and O. C. Nwankiti[4]

1 Introduction

Maize *(Zea mays L.)* provides, world wide, ober 20 million tonnes of proteins to humans annually, (Anon, 1967). In Nicaragua, El Salvador, Guatemala und Honduras maize supplies over 60 % of the total human daily calorie intake and 11 % in Panama and 34 % in Costa Rica, (Bressani, 1966). In Afrika, maize consumption could compare well with that of Guatemala, accounting for about 64 % of the total daily caloria intake of the rural dwellers especially during the "hunger period".
In Southern Nigeria, maize has been the principal cultivated cereal until the introduction of rice and has been used primarily for human food. It is eaten as whole grain when roasted or boiled and used in its prepared form as pap (Ogi) or Eko (Agidi) which is an extracted starch meal obtained after a prolonged soaking of maize. Maize consumption in Western States of Nigeria varies from 2.6 to 2.8 kg per person per week, (Agboola, 1979). In the Eastern States, Abakaliki area was indentified to be the highest consumer of maize diets which was estimated at 0.5 kg per person per week (Agboola, 1979).

Protein is an expensive but necessary constituent of human food. It constitutes about 10-11 % of the whole maize kernel and most of the nitrogen in maize is present in the form of protein. Relatively small amounts of non-protein nitrogen are found in maize

1) 2) Dr. I. U. Obi and O. A. Oluro, Senior Lecturer and former student, respectively, Crop Science, University of Nigeria Nsukka, Nigeria
3) Dr. B. N. Okwuosa, Senior Lecturer, Department of Animal Science, University of Nigeria, Nsukka, Nigeria
4) Dr. O. C. Nwankiti, Reader, Department of Botany, University of Nigeria, Nsukka, Nigeria.

and over 50% of this non-protein nitrogen is in the form of amino acids, (SAMUEL, 1969).

The protein content of local unimproved maize differs with cultivars and the level of soil fertility with respect to nitrogen availability. Varying ranges of percentage protein have been reported for local maize cultivars elsewhere. For example JOVANIC et al., (1977) reported a range of 11-12.25%. AUSTIN and AHIYA (1975) gave 10-11.48%; MANYALA (1975) gave 7-11.81% and ADRIAN, (1973) reported a range of 4-8.2%. These workers concluded that high inclusion rate of local maize in human diets would lead to severe protein malnutrition. This finding is of economic importance to the livestock producer who uses high levels of maize in livestock feed (70-80%). There is a need on his part to provide balanced diets with the right levels of protein and adequate amino acids to maximize production in his animals.

DUDLEY and LAMBERT (1969) demonstrated that through long term selection the protein content of maize can be altered. They showed that with 65 generations of selection of a local Burr white variety that contained 10.90% crude protein in Illinois, a final high protein strain of 25.2% protein was obtained. This is the famous Illinois high protein corn. Although the long term selection and nitrogen fertilization experiments demonstrated that protein content of maize could be altered, the practical importance of the findings is in the nutritional value of the grains.

Technological progress has made it possible for numerous consumers to indulge in a variety of maize based foods. In the more advanced countries, in addition to the livestock feeds, other maize-based products such as corn bread, tooth paste, corn sugar, alcohol, drug-base to name a few are made with maize. This apparent economic importance of maize, therefore, justifies the study reported here.

The objectives of this study are (a) to classify Nigerian maize cultivars into percentage protein level groups and (b) to recommend areas for maize collection for high protein content for use in a breeding programme for quantity and quality of protein.

The maize samples surveyed have not been subjected to selection for protein content. It is also, the first time percentage protein distribution of Nigerian local maize is being reported. Thus, the values obtained should reflect ranges one could expect in an unselected maize population in Nigeria. Also, the samples represent areas where local maize production is most concentrated.

2 Materials and Methods

The local maize germplasm sources from Anambra, Imo, Bendel, Kaduna, Benue and Cross River States were collected by Drs I. U. Obi, B. N. Okwuosa and O. C. Nwankiti, of Department of Crop Science, Animal Science and Botany, respectively, Uni

versity of Nigeria, Nsukka, Nigeria, in a joint local maize germplasm collection and research programme financed by the Senate Research Grant Number 00209/76. The samples are maintained and used in various maize breeding and research programmes in the Department of Crop Science of the University. Two hundred and thirty (230) samples of these collections were used in this study. Twenty-four improved varieties included as control were from Oyo, Anambra and Urbana – Illinois, U.S.A..

2.1 Sample preparation

The maize samples were dried in Gallenkamp oven model OV-440 at 80°C for 24 hours, as recommended by DEUBLEIUS (1978). The samples were ground to pass through a 1 mm sieve with a Thomas-Wiley mill, model 4.

2.2 Protein determination

Micro-Kjeldahl method was used to determine total nitrogen as recommended by the Association of Official Agricultural Chemists (A.O.A.C.), (1965). Analysis for nitrogen was performed on duplicate 1 g of ground sample. Per cent protein was calculated as N x 6.25.

2.3 Statistical analysis

The calculated percentage protein values of the 230 local maize cultivars and the 24 improved cultivars included in the study as control were compared using frequency distributions by means of histograms. Such descriptive measures as the mean, mode, range and standard errors (S.E.) were estimated for the cultivars. Analysis of variance (ANOVA) was performed to compare the percentage protein values from the five states; Anambra, Bendel, Benue, Cross River and Imo, emphasized in the study. The same ANOVA was used to estimate the effect of seed colour on protein content.

3 Results and Discussion

The crude protein content of the samples of local maize cultivars and the improved varieties are reported. Crude protein values reported in percentage of whole kernel basis ranged from 6.27-16.63 % for the locals and 7.00-30.21 % for the improved varieties. The percentage crude protein distribution in the local cultivars (Fig. 1, A) showed a skewed distribution with a mean of 9.02 %, range of 10.36 % and mode of 7.72 %. The improved varieties had a similar distribution pattern. However, the mean, range and mode were 12.80, 23.21 and 14.00 % crude protein, respectively (Table 1 and Fig. 1, B).

Comparatively, the local cultivars had a lower mean and range of percentage crude protein than the improved varieties with the crude protein values of the local cultivars

clustering between 7.42 and 8.58% (Fig. 1A). The improved varieties clustered between 7.00 and 10.87%, (Fig. 1, B). However, all the improved varieties were not primarily improved or selected for high protein content.

The results of the analysis of variance (Table 3) showed that differences in percentage protein content of the cultivars between states were not statistically significant. However, States with consistently low mean percentage protein values include Benue and Cross River while Anambra, Bendel and Imo States have the highest mean percentage crude protein (Tables 2 and 3). Soil fertility is known to affect protein percentage, ALBINET, (1978) and hence one can infer that soils of Anambra, Bendel and Imo States of Nigeria are more suited for maize production for protein yields. Mean percentage crude protein values for Anambra, Bendel and Imo States are 9.64, 10.15 and 9.50%, respectively. No inference could be drawn from Kaduna since only one sample was collected. It is likely that faster advances in selection for protein content could be made with maize germ plasm from Anambra, Bendel and Imo States.

Table 1: Mean, range, mode and standard error of percent crude protein in 230 local and 24 improved varieties of maize.

Maize cultivars	Mean	Range	Mode	S.E.
Improved	12.80	23.21	14.00	1.15
Unimpro./Local	9.02	10.36	7.72	1.64

Table 2: Mean, percent protein of 230 local maize cultivars from six states of Nigeria.

State of origin	Crude Protein (%)
Anambra	9.64
Bendel	10.15
Benue	8.33
Cross River	8.82
Imo	9.50
Kaduna*)	10.50

* Only one sample was available for analysis.

Table 3: Mean Per cent Protein in 230 Local Maize Cultivars From Different States in Nigeria Based on the Major Seed Colours.

State	Yellow	White	Mean*)
Anambra	8.72	10.55	9.64
Imo	10.12	8.87	9.50
Cross River	9.26	8.36	8.82
Bendel	9.99	10.30	10.15
Benue	8.15	8.50	8.33

* Mean differences are statistically non-significant as determined by a preliminary F-test.

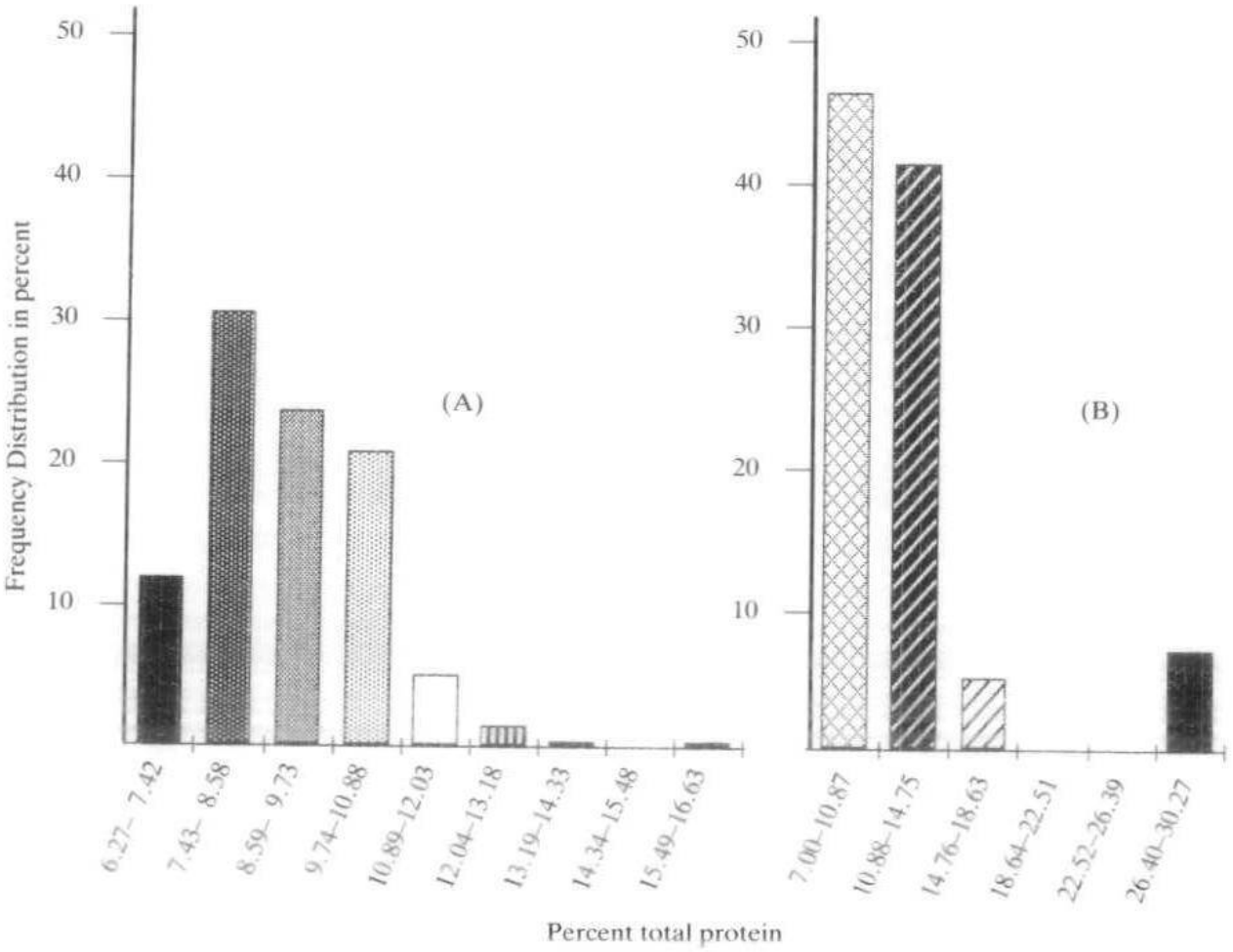

Fig. 1: Percent protein distribution of unimproved (A) and improved (B) Nigerian local cultivars of maize.

Although maize will grow on all soils except pure sand, it however, performs better on well aerated, deep, warm, sandy loams and silt loams, containing adequate organic matter and other nutrients, SAMUEL, (1969). These types of soils are typically found in areas of high rainfall like Bendel and Imo States, as well as in parts of Anambra and Cross River States. It was also, observed that seed colour had no effect on the protein content of the surveyed local cultivars (Table 3).

4 Summary

The percentage protein content of Nigeria local maize cultivars studied ranged from 6.27 to 16.63% with a mean, range and mode of 9.02, 10.36 and 7.72%, respectively. These values were lower than those obtained for the improved varieties which had a mean, range and mode of 12.80, 23.21 and 14.00% protein, respectively and ranged from 7.00 to 30.21%. These findings are to be expected from a maize population that was not selected for high protein content. The results revealed that maize collections from Benue (8.33% protein) and Cross River (8.82% protein) had lower mean percentage protein content than those from Anambra (9.64% protein), Bendel (10.15% protein) and Imo (9.50% protein) States of Nigeria. The differences in percentage protein content of the cultivars between States were statistically non-significant (Table 3). However, it could be inferred that Anambra, Bendel and Imo States are better suited for production of maize with high protein content. Therefore, faster advances in selection for high protein content could be made with the maize germ plasm from Anambra, Bendel and Imo States.

Zusammenfassung

Der prozentuale Proteingehalt der untersuchten lokalen nigerianischen Maissorten lag zwischen 6,27 und 16,63%, mit dem arithmetischen Mittel von 9,02, einer Streuung von 10,36 und dem häufigsten Wert von 7,72%. Diese Werte waren niedriger als die der verbesserten Varietäten, die zwischen 7,00 und 30,21% lagen, mit dem Mittel von 12,80, einer Streuung von 23,21 und dem häufigesten Wert von 14,00%. Diese Befunde wurden bei einem Maisbestand erzielt, die nicht auf einen hohen Proteingehalt selektiert worden sind.

Die Ergebnisse ergaben, daß die untersuchten Maisbestände aus den Staaten Benue (8,33% Protein) und Cross River (8,82% Protein) im Mittel einen niedrigeren Proteingehalt hatten als die aus den Staaten Anambra (9,64% Protein), Bendel (10,15% Protein) und Imo (9,50% Protein). Der Unterschied des prozentualen Proteingehaltes der Sorten in den Staaten war statistisch nicht signifikant, s. Tab. 3.

Jedoch muß gefolgert werden, daß die Staaten Anambra, Bendel und Imo bessere Bedingungen haben für die Maisproduktion mit hohem Proteingehalt. Daher können

mit Maiskeimplasma aus den drei Staaten schnellere Fortschritte in der Selektion für hohen Proteingehalt erzielt werden.

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