NARP SORGHUM AND MILLET PROGRAMME

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FUNCTIONAL CHARACTERISATION OF SOME MILLET VARIETIES IN GHANA

BY

John T. Manful

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INTRODUCTION

Pearl millet is one of the four major cereals cultivated in Ghana in terms of area and yield. The others are maize, sorghum and rice. The average area cultivated yearly for millet is about 208,000 ha with an average yield of 0.7 t/ha. The average total production annually is about 155,000 tonnes. However, it has been projected that 2.0 t/ha yields are achievable in Ghana under better management conditions.

The average per capita consumption of millet in Ghana is estimated to be about 17.3 kg/person/year. Millets are generally cultivated in the Northern, Upper East and Upper West Regions of Ghana with smaller quantities being grown in the Volta and Brong Ahafo Regions.

The proximate composition of millet is affected by both the environment and genetics. Pearl millet usually has a higher protein and fat content than sorghum. Reported protein content of millet range from 5.6 to 14.8% and these compare favourably with maize and wheat. Compared to maize, sorghum and wheat, millet has very high mineral content (Serna-Salidivar et. al., 1991)

Millet is a traditional cereal staple of the northern regions of Ghana. It has a wide range of food uses including *tuo*, (a stiff porridge), *koko* (a thin porridge), *maasa* (a fried cake) and *fura* (a beverage) among others. Traditionally, it is the preferred cereal for both *tuo* and *koko* preparations. In recent times, it has been overtaken by maize as the main *tuo* cereal in most urban areas of the north. This is however due to the fact that millets are more expensive than maize and a light colour has come to be associated with good quality *tuo* in urban areas and maize is thought to provide a ''better product".

With the increasing number of varieties being worked on by plant breeders and agronomists, and the need to provide farmers with the most desirable varieties, it has become necessary to characterise these according to their nutritional and other functional properties to ensure that the varieties with the most desirable characteristics are eventually released to farmers.

MATERIALS AND METHODS

Five varieties of millet namely ICMV IS 92202, ICMV 8201, ICMV IS 89305, Manga Nara and the local late millet were received from the Plant breeders at the Savanna Agricultural Research Institute.

The following analyses were carried on them.

- Proximate compositions were determined using the AACC (1986) Standard Methods
- Tannin content of the varieties were determined using the procedure of Burns (1963), Maxon and Rooney, (1972) and Price et. al. (1978).
- Pasting properties using the Brabender Viscoamylograph.
- Dehulling yield using the Tangential Abrasive Dehulling Device (TADD).

  Dehulling yield classifications were as follows:

  - 75% and above - Very good yield
  - 65% to 75% - Good yield
  - 55% to 65% - Intermediate yield
  - 40% to 55% - Poor yield
  - Less than 40% - Very poor yield

- Grain size analysis and other physical attributes according to Gomez et al. (1997). The following classifications were used.

  Vitreousness:

  - 1 = Very vitreous
  - 2 = Vitreous
  - 3 = Intermediate
  - 4 = Floury
  - 5 = Very floury

Floaters Test

- Less than 10% - Very dense grains
- 10% to 30% - Dense grains
- 30% to 50% - Intermediate
- 50% to 70% - Low density grains
- More than 70% - Very low density grains

RESULTS AND DISCUSSION

The moisture content ranged from 8.0% to 9.6% (Table 1). The local late millet had a low ash content of 1.5% while ICMV IS 92202 had the highest ash content of 2.1%. This variety (ICMV IS 92202) also had the highest protein content of 15.5% giving an indication that it could be considered in a formulation of infant foods. On the other hand the local late millet had the lowest protein content of 10.9%. Despite this low protein level, it would be interesting to evaluate its malting potential for use in malted grain products. ICMV 8201 and Manga Nara have very high fat content of 7.2% and 6.7% respectively while the local late millet had the lowest fat content of 5.9%. With these high levels of fat, it must be noted that and any flours produced from these varieties without proper degerming would be unstable and prone to rancidity.

Table 2 shows the mineral and tannin content of the millet varieties. ICMV IS 92202 had the highest calcium content of 22.2 mg/100g of sample with the Local Late Millet having the least calcium content of 12.3mg/100g. The iron content of the varieties fell within a narrow range of between 3.9mg/100g for Manga Nara to 2.3mg/100g for the Local Late Millet. The Local Late Millet had the highest phosphorus content of 108mg/100g while the least phosphorus content among the varieties of 79mg/100g of sample was found in ICMV IS 89305. The tannin contents of the varieties were as expected very low with ICMV 8201 having the highest tannin content among the varieties of 0.71mg CE/g of sample.

The grain size fractions of the millet varieties are shown in Table 3. ICMV IS 89305 had the smallest grain size with 64.9% being retained on the 2.00mm sieve followed by ICMV 8201 with 71.6% being retained on the same sieve. The remaining varieties namely Manga Nara, ICMV IS 92202, Long Early Yellow and the Local Late Millet all had over 80% of their grains being retained on the 2.00mm sieve. These varieties could therefore be classified as large-grained varieties.

Table 4 shows some further grain characteristics of the millet varieties. ICMV IS 89305 and ICMV 8201 had the least 1000 grain weights of 7.33g and 8.66g respectively. Manga Nara had the highest 1000 grain weight of 13.33g followed by the Local Late Millet with 10.00g. These follow the same pattern as the grain size fraction analysis as the 1000 grain weight is also an indicator of grain size. The vitreousness of the varieties ranged from 3.53 for Long Early Yellow to 4.60 for Local Late millet on a Scale of 1 to 5 (1 = Very vitreous and 5 = very floury). All the varieties very therefore classified as either of intermediate vitreousness or floury. The % floaters of the varieties is also reported in Table 4. ICMV IS 92202 had the highest percent floaters with 60.3% of the grains floating followed by the Local Late Millet with 59.0%. These two varieties are therefore classified as being of low density. The remaining varieties had percent floaters ranging from 31.0 for Manga Nara to 45.7 for Long Early Yellow. These varieties are classified to be of intermediate density. There was a wide variation in the dehulling properties of the varieties. The Local Late Millet had the least dehulling yield of 32.8% and was classified as being very poor followed by the Long Early Yellow with a poor dehulling yield of 48.3%. Manga Nara had a good dehulling yield of 65.8%. The remaining varieties had average dehulling yields.

Table 5 shows the pasting characteristics of the millet varieties. Pasting temperatures ranged from 79.0°C for ICMV IS 89305 and the Local Late Millet to 83.9°C for ICMV 92202 and ICMV 8201.

Generally peak viscosities for the varieties were low with the highest being the Local Late Millet having a viscosity of 440BU. ICMV IS 92202 had a very low peak viscosity of 87BU. The hot paste viscosity which is the viscosity of the paste after holding it at 95°C for 20min was also very low for the varieties. The Local Late Millet again had the highest hot paste viscosity of 210BU. Hot paste viscosities for ICMV IS 92202, ICMV 8201 and Manga Nara were 25BU, 60BU and 60BU respectively. The cold paste viscosity namely the viscosity of the paste after cooling to 50°C for the Local Late Millet was 410BU. ICMV IS 89305 was a distant second with a cold paste viscosity of 197BU.

Some viscoamylographic indices of the millet varieties are shown in Table 6. The breakdown of the starch is the difference between the peak viscosity and the hot paste viscosity. This parameter showed wide variation among the varieties. The Local Late Millet had the highest breakdown of 260BU with ICMV IS 92202 having the lowest breakdown of 62BU. The total setback which is the difference between the cold paste and the hot paste viscosity followed a similar pattern as the breakdown values. The Local Late Millet had the highest total setback of 230BU with ICMV IS 92202 having the lowest value 53BU.

CONCLUSION

Millet variety ICMV IS 92202 had the highest protein content of 15.5% and could therefore be considered for formulation of infant foods.

The Local Late millet (SARI Manga) despite its relatively low protein content of 10.9% could also be considered for malted millet product formulations.

Tannin contents in the varieties were very low confirming that tannins are generally not a problem in millet. It may be of interest to investigate the levels of phytates in the samples as these are generally more of a problem in millets than tannins.

Manga Nara and the Local Late millet had the largest grain sizes while ICMV IS 89305 and ICMV 8201had intermediate grains.

On the dehulling properties, Manga Nara had a good dehulling yield of 65.8% while that of the Local Late Millet was very poor yielding 32.8%.

The Local Late Millet had a cold paste viscosity of 410 BU which makes it by far the best millet variety amongst the lot for the local *tuo* preparation. The remaining millet varieties may be good for the thin porridge *koko* preparation.

References

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Table 1. Proximate Composition of Millet Varieties

Variety	% Moisture	% Ash	% Protein	% Fat
ICMV IS 92202	8.4	2.1	15.5	6.1
ICMV 8201	8.0	1.7	12.5	7.2
ICMV IS 89305	8.3	1.8	13.5	6.2
Local Late Millet	9.6	1.5	10.9	5.9
Manga Nara	8.1	1.6	12.4	6.7

Table 2. Mineral and Tannin Content of Millet Variety

Variety	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)	Tannin (mg CE/g)
ICMV IS 92202	22.2	3.4	98.0	0.17
ICMV 8201	14.1	3.5	86.0	0.71
ICMV IS 89305	15.4	2.5	79.0	0.18
Local Late Millet	12.3	2.3	108.0	0.26
Manga Nara	19.2	3.9	87.0	0.28

Table 4: Grain Characteristics of Some Millet Varieties

Variety	1000 Grain Weight	Vitreousness	%Floaters	Dehulling Yield
ICMV IS 92202	9.33	3.90	60.3	58.8
ICMV 8201	8.66	3.56	39.3	64.5
ICMV IS 89305	7.33	4.20	39.0	63.0
Manga Nara	13.33	3.96	31.0	65.8
Local Late Millet	10.00	4.60	59.0	32.8
Long Yellow Early	9.33	3.53	45.7	48.3

Table 4: Grain Characteristics of Some Millet Varieties

Variety	1000 Grain Weight	Vitreousness	%Floaters	Dehulling Yield
ICMV IS 92202	9.33	3.90	60.3	58.8
ICMV 8201	8.66	3.56	39.3	64.5
ICMV IS 89305	7.33	4.20	39.0	63.0
Manga Nara	13.33	3.96	31.0	65.8
Local Late Millet	10.00	4.60	59.0	32.8
Long Yellow Early	9.33	3.53	45.7	48.3

Table 3: Percent Grain Size Fractions of Some millet Varieties

Variety	% Retained on Sieve (Mesh Opening)				
	2.80mm	2.00mm	1.18mm	1.00mm	Pan
ICMV IS 92202	1.9	82.3	15.6	0.2	0.0
ICMV 8201	5.4	71.6	22.7	0.3	0.0
ICMV IS 89305	0.3	64.9	34.6	0.2	0.0
Manga Nara	9.8	80.8	9.4	0.0	0.0
Local Late Millet	7.6	86.8	5.4	0.2	0.0
Long Yellow Early	2.8	84.8	12.4	0.0	0.0

Table 5. Pasting Characteristics of Some Millet Varieties.

Variety	Pasting Temperature (° C)	Peak Viscosity (BU)	Viscosity at 95°C (BU)	Hot Paste Viscosity (BU)	Cold Paste Viscosity (BU)
ICMV IS 92202	83.9	87	30	25	78
ICMV 8201	83.9	200	70	60	180
ICMV IS 89305	79.0	210	100	78	197
Local Late Millet	79.0	440	210	180	410
Manga Nara	81.0	165	60	60	158

Table 6: Viscoamylographic Indices of Some Millet varieties

Variety	Breakdown [P –H]	Setback [C –P]	Total Setback [C –H]	Relative Breakdown [(P-H) / (C-H)]	Breakdown Ratio [H / P]	Setback Ratio [C / P]	Total Setback Ratio [C / H]
ICMV IS 92202	62	-9	53	1.17	0.29	0.90	3.12
ICMV 8201	140	-20	120	1.17	0.30	0.90	3.00
ICMV IS 89305	132	-13	119	1.11	0.37	0.94	2.50
Local Late Millet	260	-30	230	1.13	0.41	0.93	2.28
Manga Nara	115	-7	98	1.17	0.36	0.96	2.63