CHARACTERIZATION OF SOME RELEASED SORGHUM VARIETIES AND FOR FOOD AND INDUSTRIAL UTILIZATION IN NIGERIA

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Abstract

Seven sorghum varieties and three sorghum lines were analysed for their biochemical composition, effect of malting time on cold water extract (CWE %), malting loss. Samsorg-3, Samsorg-7, Samsorg-41, SRN 4841, Samsorg-38, SSV 98001, NR 71168 and NRL 3 had protein content above 12%. SRN 4841 had the highest carbohydrate of 85.30. SRN 4841 gave highest cold water extract (CWE %) of 103.62% at day 6. There was significant (0.05) correlation between days to flowering and carbohydrate (r = 0.37). Plant height showed negative correlation to protein content. Yield was negatively significantly correlated to protein content (r = -0.545). Some of the sorghum varieties have been identified to be useful as nutritious source of food and for use in the malting industry.

Key words: plant, sorghum, food, industrial utilization.

INTRODUCTION

Sorghum is by far the largest staple cereal crop in Nigeria. The bulk of it is estimated production of about 8 million tonnes (NAERLS; 1996) are grown in the Northern Guinea and Sudan/Sahel ecologies, this covers states like Kaduna, Kano, Jigawa, Zamfara, Sokoto, Kebbi, Borno, Plateau, Bauchi, Adamawa and Gombe.
The most important objectives of the crop Improvement programme of the Institute for Agricultural Research (IAR), Ahmadu Bello University is to develop cultivars that are high yielding, with good grain quality for food and for industrial utilization since many confectionery and brewing industries are using sorghum grains for their various products. For instance, out of the 8 million metric tonnes of sorghum produced in Nigeria, only an estimated 120,000 metric tonnes are utilized by the industries (Murty *et* al., 1996). The increased use of white grain sorghum by breweries in Nigeria has resulted in competition in the market between grain food and grain for brewing purposes. This problem led to the undertaking of this studies in order to identify varieties specific for food and other malting and brewing purpose (Ikediobi, 1990).

Sorghum, like other cereals, is an excellent source of starch and protein and can be processed into starchm flour, grits and flakes which can be used to produce a wide range of industrial products (Palmer, 1991). It is in line with the above that some of the recently developed (released) varieties from IAR were characterized for food and industrial utilization.

MATERIALS AND METHODS

Seven improved and three advanced lines of sorghum were evaluated for yield for two years to acquint the users with the average yield of these varieties and lines. Similarly the same materials were tested for their biochemical compositions, and germination characteristics, percent malting loss, effect of malting time on cold water extraction (CWE%) and hot wat er extraction were undertaken. The biochemical composition of all the different cultivars was done using procedures outlined by Morris (1958).

The Descriptions of the materials are given below: (tab.1.)

Tab. 1. : Description of materials

Materials	Description
1. SSV 98001	This is a local collection large white seed, early maturing open panicle (75-85D to flowering). 1,500 – 3.000kg/ha. Plant height 180 – 220cm. Not yet release.
2. SAMSORG-8(KSV 14)	Photoinsenstive Selection from Naga white (L9289xC. E90 Semi-dwarf, open panicle, whites seeded early maturing 70-85-days to 50% flowering, average yield 1,800-3,000kg/ha, plant height 140-150cm. Resistant to major leaf diseases.

3. SAMSORG-6 (KSV 12)	Photoinsenstive, Selection from an introduced germplasm from Niger Republic with pedigree 137/63 (L.2280/79).Semi-dwarf, Semi-compact panicle, white seeded. Average yields 3,500- 4,500kg/ha under high fertility. Plant height 180-200cm.
4. SAMSORG-41(ICSV III)	Developed at ICRISAT Asia Center in Patancheru in India. Photosensitive, early maturing 65 – 75 days to a 50% flowering, semi compact panicle, white seeded. Average yield 4000-6000kg/ha in high fertility. Plant height 160-200cm.
5. SAMSORG-3(KSV4-BES)	Developed as an early maturing selection from local germplasm introduced from Bauchi state. Semi-dwarf, Semi-compact panicle cream coloured seeds. Maturing 75-85 days to 50% flowering. Average yield 1400-2,500kg/ha, Plant height 140 – 150cm. Tolerant to *Striga haemontheca*.
6. SAMSORG-38(NR71176)	A selection from an introduced material from Sudan through ICRISAT. Pedigree SN-192-5-1. Early maturing 75 – 85 days to 50% flowering. Semi-dwarf, semi-compact panicle, cream coloured seed, early maturing 75 – 85 days to flowering. Average yield 1,700 – 3,000 kg/ha, plant height 140 – 150cm.
7. SRN 4841	Photosensitive, introduced material from Sudan? Semi-dwarf. Compact panicle, red seeded early maturing 70-80 days to 50% flowering. Striga resistant.
8. SAMSORG-7 (KSV 13)	Photosensitive, Selection from an introduction. Semi dwarf, semi-compact panicle, white seeded. Early maturing 75 – 85 days to flowering. Average yields 1,800 – 2,500 kg/ha. Plant height 140 – 150cm.
9. SAMSORG 39 (NR71168)	A selection from an introduced material from Sudan. Not yet release. Early maturing 75 – 85 days to 50% flowering. Semi-dwarf, semi-compact panicle. Cream seed. Average yields 2,500 – 3,500 kg/ha.
10. NRL 3	Selection from a local garmplasm. Not yet release. Late to Medium Maturing 90 to 110 D to flowering. Cream seed. Average yields 3,000 – 4,000 kg/ha.

RESULTS AND DISCUSSION

The biochemical composition and germination characteristics of the ten sorghum cultivars are given in tab. 2. The moisture content of the cultivars ranged from 1.2% for SRN 4841 to 2.58% for Samsorg 38. The low moisture content in all the cultivars suggests good storability of the grains before processing. Of the ten cultivars Samsorg-3,7,41,SRN 4841, Samsorg-38, SSV 98001 and NR 71168 had protein percentage greater than 12% which compares favourably with that of barley (8-13%), the traditional malting crop. Thus the suitability of worth from these sorghum malt for yeast nutrition is assumed, since this depends on the total soluble nitrogen (TSN) and free amino nitrogen (FAN) levels. The embryo of sorghum is larger than that of barley and contains more unsaturated lipids (e.g. linoleic acid) (Palmer, 1991). The lipid content of all the sorghum cultivars analysed ranged from 1.22% for Samsorg 6 (KSV 12) to 5.36% for NRL3, low level of fat is encouraging because it extends the keeping quality of the product by reducing rancidity (Aba *et al.*, 2001). High level of Ash (1.06 - 3.31%) in the cultivars analysed, which is greater than that of barley (2.496%) seems to suggest the availability of mineral elements being sufficient for yeast nutrition and alcohol production as required by brewers. All the cultivars analysed are of low tannin (0.081 – 0.068%) and cyanide (0.001 –0.082) indicating that they are safe for use either as dry grain or malted grain. Results of germination energy and germination capacity show that except for Samsorg-7 grains, other nine cultivars are of good malting quality (70%) in the range of 71-99%. Germination energy is a measure of the proportion of seeds that will germinate under the test condition, whereas germination capacity is a measure of the viable seeds in a sample. Germination energy and capacity of five cultivars Samsorg 3, 6, 40, 38, and NR 71178

compared favourably with that of barley (95 and 96%) which suggests a good grain ready for malting.

The percentage malting loss of the ten cultivars is shown in tab. 3. This reflects the economy of the malting. The percentage malting losses are in the range of 10.00% for Samsorg 3 in day 3 to 37. 50% for SSV 98001 in day 6. The high malting losses given by many cultivars seem to be a discouraging factor for those interested in malting products. The best cultivar in terms of low malting loss is Samsorg 3. This cultivar has been used by previous malting industries (Ikediobi, 1988) as HQSV. Although high malting losses of sorghum 16-22% than that of barley have been attributed to the naked nature of the sorghum grain in contrast to barley grains with husk. It has therefore been suggested that methods of calculating real malting losses should be accordingly modified or adjusted (Ikedeobi, 1988). Low malting loss may be indicating high extract yield in the malted grain.

Effect of malting time on cold water extract (CWE%) of the ten cultivars is shown in tab. 4. Extract yield remains an index of malting quality and an important measure of brewing house performance of the malt. The malting extract time on cold water (CWE%) of the cultivars shows that most of them gave higher extract yield than previously reported for Samsorg 17 (SK 5912). The values ranged from 20. 73% for Samsorg 3 to 88. 69% for NR 711768 in 4 days, while it ranged from 41.45 for Samsog 38 to 103.62 for SVR 4841 for day 6.

It may then follow that most of the varieties reported here which have more protein content have more endosperm than germ (12.56 – 16.45%) and higher than the low average of 10.1% (Bredon, 1961) and also higher than 11.0% reported by Rootney (1980) and some still have protein content higher than the high average of 13.6% (Lamar *et al.*, 1972) evaluated for normal non-opaque sorghum. Most of the varieties evaluated here seem to be more nutritious than those evaluated by Obilana and Okon (1983), Rooney *et al.* (1980) and Lamar *et al.* (1961). This allows the farmers to make a choice of which variety they want to grow for food or which they could grow for industry use.

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REFERENCES

ABA, D. A., ABU, A. E. AND CHINDO, P. S. (2001). In Report of the Food Science and Technology Programme Submitted for the IAR Cropping Scheme Meeting for 2001. 13 pp.

BREDON. R. M. (1961). In: Report of Uganda Government Department Vet. Sci. And Animal Industries (Cyclostyled).

IKEDIOBI, C. O., ONYIA, G. O. C., ELUWAH E. C. (1988). A rapid and inexpensive enzymatic assay for total cycinide in Cassava and cassava products. Agric. Biological Chemical 44 (12): 2803-2809.

IKEDIOBI, C. O. (1990). In : Summary of Proceedings of symposium on the current status and international crop potentials of industrial uses of sorghum in Nigeria. Institute for Agricultural Research, Ahmadu Bello University, and International Institute for Semi-Arid Tropics (ICRISAT). 59 pp.

LAMAR, ET AL. (1972). Cereals quality laboratory of the sorghum improvement research programme of Texas Agric. Exp. Sta.

MORRIS, B. JACOBS (1958). The chemical analysis of foods and food products. 3rd edition. By D. Van Nostand Company Inc. 966 pp.

MURTY, D.S., S.A. BELLO AND C.C. NWASIKE (1996). Status and breeding requirements for sorghum utilization in Nigeria. In: Proceedings of the International Conference on Genetic Improvement of Sorghum ad Pearl Millet. September. 23-27.

NAERLS (1996). Prospects and problems of the 1996 cropping season. A report of study conducted by National Agric. Extension and Research Laision Services and Agricultural planning monitoring and Evaluation Unit (APMEU) 20TH September – 4th October 1996 NAERLS, Ahmadu Bello University, Zaria. Nigeria 62 pp

OBILANA, A. T. AND OKON, P. N. (1983). Relationship between some agronomic and physico-chemical traits in long season sorghum. Z. Pflanzenzuchtg 92, 239-248 ISSN 004-3298 Intercode: ZEPZAD. Berlin und Hamburg.

PALMER, G. H. (1991). Sorghum – Food Beverage and Brewing Potentials. Review Process Biochemistry 27(1992): 145-153.

ROOTNEY, L. E., M.N. KHAN AND C. F. EARP. (1980). The technology of sorghum products. In: Cereals for Food and Beverages. New York: Academic Press Inc.

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Tab. 2: Biochemical Composition and germination characteristics of Ten Sorghum cultivars (%)

Characteristics	KSV 4	KSV 8	KSV 12	KSV 13	ICSV III	SRN 4841 (Improved)	SSV 98001	NR 71176	NR 71168	NRL 3
Moisture	1.40	1.37	1,76	1.92	2.96	1.20	1.42	2.58	1.98	2.43
Protein	12.92	15.69	15.55	13.44	11.73	10.08	14.46	10.83	12.56	16.45
Lipid	2.55	2.29	2.22	3.41	5.22	3.56	2.30	2.48	3.32	5.36
Carbohydrate	82.97	80.72	80.95	81.94	81.97	85.30	81.20	84.81	80.88	74.88
Ash	1.56	1.30	1.31	1.26	1.08	1.06	2.04	1.88	5.24	3.31
Tannin	0.0081	0.012	0.0084	0.013	0.0012	0.0268	0.029	0.020	0.020	0.067
Cyanide	0.0001	0.0001	0.0040	0.0079	0.015	0.033	0.018	0.017	0.0066	71
Germination energy	90	93	93	63	90	82	72	96	90	75
Germination capacity	99	97	99	66	99	82	72	96	90	

Values are means of triplicate determinations.

Tab. 3 : Percentage Malting Loss of Ten Sorghum Cultivars

Day	KSV 4	KSV 8	KSV 12	KSV 13	ICSV III	SRN 4841 (Improved)	SSV 98001	NR 71168	NR 71176	NRL 3
1	3.33	3.33	6.67	11.92	6.67	9.68	12.50	3.33	9,09	6.06
2	8.33	11.67	8.00	13.03	10.00	12.90	13.13	8.33	11.36	12.12
3	10.00	13.33	13.33	13.41	13.33	16.13	15.63	10.00	13.64	15.15
4	10.00	20.00	16.67	15.71	20.00	24.19	18.75	10.00	18.18	16.97
5	11.67	21.67	16.67	19.54	23.33	25.81	21.88	13.53	22.75	18.18
6	13.33	26.67	20.00	23.37	26.67	27.42	37.50	15.00	29.55	19.70

Tab. 4: Effect of Malting Time On cold Water Extract (CWE %) Of Ten Sorghum Cultivars.

Day	KSV 4	KSV 8	KSV 12	KSV 13	ICSV III	SRN 4841 (Improved)	SSV 98001	NR 71168	NR 71176	NRL 3
2	15.54	10.36	17.27	15.54	17.27	17.27	20.73	17.25	20.73	16.99
4	20.73	20.73	19.43	18.13	22,02	20.73	21.08	22.17	21.08	19.43
5	21.08	25.09	20.73	20.73	20,73	21.48	21.45	23.32	21.45	22.02
6	20.18	25.09	23.32	20.73	25.91	23.32	20.72	24.61	20.72	18.68

Tab. 5: Correlation's between Yield components and their biochemical components.

Characteristics	1	2	3	4	5	6	7	8	9	10	11	12
50% Days to flowering (1)	1.00	-0.0428	.5145**	-0.302	-0.221	0.070	0.385*	0.174	0.037	-0.050	-0.04	-0.019
Plant height (2)	-0.043	1.00	-0.0455	-0.825**	0.0028	-0.124	0.21	-0.411*	-0.159	0.086	-0.121	-0.293
Yield Kg/ha (3)	0.515**	-0.046	1.00	-0.459**	0.103	0.445**	0.680**	-0.218	-0.220	0.608**	0.175	-0.545**
Germination capacity (4)	-0.303	-0.835**	-0.458**	1.000	-0.279	-0.195	-0.595**	0.425*	0.283	-0.387*	-0.060	0.450**
Germination energy (5)	0.221	0.003	0.103	-0.279	1.000	0.0385	0.0475	0.148	-0.032	-0.0567	0.027	-0.059
Cycide (6)	0.070	0.124	0.445**	-0.195	0.0385	1.000	0.856**	-0.281	-0.457**	0.788**	0.193	0.067
Tannis (7)	0.385*	0.210	0.680**	-0.595**	0.048	0.856**	1.000	0.365*	-0.455**	-0.763**	0.246	-0.334*
Ash (8)	0.174	-0.411*	-0.218	0.425*	0.148	-0.281	-0.365*	1.000	0.888**	-0.494**	0.126	-0.574**
Carbonhydrate (9)	0.037	-0.160	-0.219	0.283	-0.032	-0.457**	0.455**	0.888**	1.000	-0.420*	0.157	0.395*
Lipid (10)	-0.051	0.086	0.608**	-0.387*	-0.057	0.788**	0.763**	-0.494**	-0.419*	1.000	0.275	-0.515**
Protein (11)	0.042	-0.121	0.175	-0.060	0.027	0.193	0.246	0.126	0.157	0.275	1.000	0.547**
Moisture content (12)	-0.019	-0.293	-0.545**	0.450**	-0.059	-0.252	-0.334*	0.514**	0.398*	-0.515**	0.547**	1.000

**Significant levels at 5 and 1 percent probabilities.