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COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

Food Research Institute

REPORT ON SORGHUM MALTING COURSE ON UTILIZATION OF LOCALLY PRODUCED SORGHUM IN THE MALTING AND BREWING PROCESS HELD AT THE CATHOLIC UNIVERSITY OF LEUVEN, BELGIUM

A PROJECT REPORT SUBMITTED UNDER THE FRI/UNIDO SORGHUM DEVELOPMENT PROJECT

BY

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FOOD RESEARCH INSTITUTE

December, 1996

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AIM: To utilize malted sorghum in brewing process.

SPONSORS: Centre for Development of Industries (CDI) of United Nations Industrial Development Organization (UNIDO)

ORGANISERS: Centre for Malting and Brewing Sciences of the Catholic University of Leuven, Herverlee, Belgium

DURATION: August – October 1996

SUBJECTS:

1. Operation and maintenance of Pilot malting plant
2. Micro, pilot and industrial malting
3. Analytical techniques for evaluation of sorghum grain
4. Analytical techniques for evaluation of sorghum malt
5. Working visits
6. Discussion

1. **Pilot malting plant:**

The five major components of the plant are:

i. Maltex. This comprises of two cylinders each capable of malting 50kg. of grains at a time. The cylinders accommodate all the malting processes. i.e. cleaning, steeping, germination and kilning.

ii. Control Panel. The plant operates automatically by a computerized system but can also be operated manually when necessary.

iii. Water Tank. Water is stored in here for all the malting purposes.

iv. Refrigeration Unit. Glycol is used in the refrigeration system to lower the ambient water temperature when necessary.

v. Air Compressor. Compressed air is used to operate several automatic valves as well as to take care of air flows during the malting stages.

In addition to these, the plant consists of several small units, including air and water connecting pipes. To operate the plant, malting parameters such as time, temperatures and air flow rates were introduced into the computer for automatic controlling of the processes. There were few occasions when manual valves had to be manipulated.

2. **Micro, pilot and industrial malting:**

Several sorghum samples (list attached) were already available at the department for malting. The four main steps of malting were studied on the micro level (laboratory) and later introduced into the Pilot malting plant.

The steps were:

i. Cleaning. Disinfectants were used to remove dirts, moulds and reduce the level of tannins.

ii. Steeping. The temperature, time and water uptake were controlled to arrive at the required moisture content of the grains.

iii. Germination. Conditions were controlled so that at the end of germination days, maximum enzyme activities were obtained in the malts to produce good fermentable worts after mashing.

iv. Kilning. Suitable temperatures and air flow rates used in the kilning process arrested germination; controlled enzyme activities, and ensured proper grain storage.

3. **Evaluation of sorghum grain** (Tables 1,2,3)

The evaluation of the grains included the following:

i. Sieving test (fractions < 2.2, 2.2, 2.5, 2..8mm)
ii Moisture content
iii Water uptake
iv. Thousand corn weight
v. Protein
vi. Germination capacity
vii. Germinative energy
viii. Contamination

4. **Evaluation of sorghum malt** (Table 4)

Hot water extract determination was carried out on the malted sorghum using a three-step mashing programme;

a) preparation of an enzymatic extract
b) gelatinization and partial liquefaction of the starch residue
c) complete liquefaction and saccharification of the mash

The following analyses were then carried out:

i. Moisture content
ii. Protein
iii. Mashing-in pH
iv. Saccharification
v. Filtration rate
vi. Wort appearance
vii. Extract yield
viii. Soluble nitrogen

SORGHUM MALT PROJECT IN GHANA

(Ref JPD 08/12/95)

(CDI file No GHA 3004. FB.03) (Contract No 332/94)

List of sorghum samples under evaluation for their malting and brewing properties

(micromalting and microbrewing)

	Variety	Origin	Harvest
S1	Belko	Tampuri	93/1
S2	Sureno	Tampuri	93/1
S3	Gambella 1107	Tampuri	93/1
S4	ICSV III	Global 2000	93/1
S5	Naga White	Tampuri	93/1
S6	Dorado	Tampuri	93/1
S7	76 ti23	Tampuri	93/1
S8	ICSH 8900 NG	Murty	92
S9	ICSU 400	Murty	92
S10	Naga White	Tampuri	Oct 94
S11	ICSV III	Global 2000	Oct 94
S12	Sureno	Tampuri	Oct 94
S13	76ti23	Tampuri	Oct 94
S14	Dorado	Tampuri	93/2
S15	76ti23	Tampuri	93/2
S16	Sureno	Tampuri	93/2
S17	Belko white	Tampuri	93/2
S18	Naga Red	Tampuri	93/2
S19	Naga White	Tampuri	93/2
S20	Sureno	JPD (Manga)	93
S21	76ti23	JPD (Manga)	93
S22	Gambella 1107	JPD (Bolgatanga)	93
S23	Dorado	JPD (Manga)	93
M1	Malt	JPD (Manga)	93

Table 1.

WATER UPTAKE (%) OF SOME SORGHUM FRACTIONS

S15		8h	24h	32h	56h
	<2.2	38.17	39.90	40.74	41.14
	2.2	36.61	38.21	38.71	39.13
	2.5	34.97	37.51	37.84	37.88
	2.8	-	-	-	-
S16					
	<2.2	40.70	44.78	44.46	43.61
	2.2	37.14	40.47	40.53	40.23
	2.5	36.09	39.63	39.86	39.56
	2.8	-	-	-	-
S17					
	<2.2	30.65	34.28	34.92	35.82
	2.2	29.55	33.54	34.84	35.47
	2.5	28.80	33.08	33.58	34.92
	2.8	-	-	-	-
S18					
	<2.2	36.69	40.71	41.69	43.25
	2.2	33.42	36.84	37.81	39.24
	2.5	32.18	35.61	36.50	38.17
	2.8	31.65	35.17	35.91	37.51
S19					
	<2.2	37.73	40.74	41.20	41.59
	2.2	35.88	38.85	39.52	40.24
	2.5	35.21	38.35	39.03	40.07
	2.8	-	-	-	-
S20					
	<2.2	40.03	42.42	44.15	42.89
	2.2	35.77	38.71	38.82	38.96
	2.5	33.29	36.08	36.31	36.65
	2.8	33.12	35.37	35.29	35.21
S21					
	<2.2	35.53	38.39	38.78	38.85
	2.2	32.52	36.19	36.69	37.25
	2.5	31.91	35.45	35.92	36.46
	2.8	-	-	-	-
S22					
	<2.2	36.27	38.60	38.50	37.95
	2.2	33.67	36.23	36.65	36.65
	2.5	32.35	35.29	35.69	36.04
	2.8	31.69	34.73	35.61	35.69
S23					
	<2.2	37.25	39.90	40.10	40.41
	2.2	33.79	36.54	36.96	37.18
	2.5	32.44	35.09	35.61	35.88
	2.8	32.91	35.73	36.04	36.19

Table2

GERMINATION (%) OF SOME SORGHUM FRACTIONS

Variety	Fraction	After 32h	After 56h
S15	<2.2	4	12
	2.2	8	20
	2.5	8	22
	2.8	-	-
S16	<2.2	0	0
	2.2	0	0
	2.5	4	4
	2.8	-	-
S17	<2.2	58	86
	2.2	84	92
	2.5	84	90
	2.8	-	-
S18	<2.2	6	24
	2.2	24	36
	2.5	36	66
	2.8	20	70
S19	<2.2	10	16
	2.2	16	38
	2.5	18	66
	2.8	-	-
S20	<2.2	0	2
	2.2	2	30
	2.5	6	48
	2.8	4	28
S21	<2.2	4	8
	2.2	12	18
	2.5	8	32
	2.8	-	-
S22	<2.2	0	10
	2.2	0	10
	2.5	4	22
	2.8	2	30
S23	<2.2	0	0
	2.2	0	14
	2.5	2	20
	2.8	4	26

Table 3

RESULTS OF ANALYTICAL EVALUATION OF SOME SORGHUM GRAINS

Variety	Moisture (%)	Thousand corn weight(g)	Total Protein (%)	Germination Energy (%)	Germinative Capacity (%)	Contamination good/average /bad
Belko	10.8	20.8	10.5	70.0	75.0	avg.
Sureno	10.5	20.4	11.1	88.0	86.0	avg.
Gambella 1107	10.6	25.0	11.3	97.0	95.0	avg.
ICSU III	10.8	21.8	10.8	85.0	86.0	avg.
Naga white	10.4	24.0	11.0	75.0	70.0	avg.
Dorado	10.3	21.5	11.2	82.0	87.0	avg.

Table 4

RESULTS OF ANALYTICAL EVALUATION OF SOME SORGHUM MALTS

Variety	76ti23	ICSH 8900NG	ICSU 400	Naga White	ICSV	Naga Red
Moisture (%)	5.6	5.8	5.5	5.6	5.4	5.2
Total Protein (%)	10.5	10.8	10.6	10.0	10.5	10.2
Mashing-in pH	5.54	5.24	5.60	5.61	5.48	5.50
Extract Yield (%)	85.6	82.4	88.2	80.2	78.6	76.4
Soluble Nitrogen (%)	0,62	0.68	0.68	0.62	0.58	0.65
Soluble Protein (%)	3.88	4.25	4.25	3.88	3.63	4.06

N/b: All the malts had opaque wort appearances, normal wort odours and slow filtration rates.

None of the malts saccharified before 60minutes

5. Working visits:

Visits were made to malt houses and breweries to get acquainted with modern malting and brewing practices. A visit to Interbrew in Leuven demonstrated how automation enables thousands of hectoliters of beer to be produced with just a skeletal staff.

6. Discussion

The knowledge acquired on the Pilot malting plant, which has now been installed at the Food Research Institute, will be of great benefit to Ghana. Breweries as well as malt related industries, import all their malt requirements because there is no industrial malt house here. The Pilot Malting Plant could be used to train potential Malsters to create industrial malt houses. The technological know-how obtained in sorghum malting would be transferred during the training programmes. The results of water uptake of different sorghum fractions (Table1), the germination (Table2) and the sorghum malt analyses (Table3) indicate the potential to evaluate sorghum varieties to feed our breweries. The malt imported into the country is produced from barley which cannot be cultivated in the tropics. The use of sorghum therefore would create an agro-based industry, attracting many farmers and reducing greatly the huge foreign exchange required to import malt.

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