

DEHYDRATION OF SPONTANEOUSLY FERMENTED MAIZE DOUGH

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by:

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## S U M M A R Y

Spontaneously fermented corn dough was dehydrated at 60°C, 100°C, 120°C and 130°C for various periods in a hot air tray drier. Dehydration resulted in browning of some of the products. Using the Lovibond Tintometer, the colour of undehydrated maize dough (control) was found to be 0.6 yellow and 0.2 red. Of the four temperatures used 60°C gave product with colour quite close to the control (0.5 yellow and 0.3 red) whilst 130°C gave the darkest colour (0.2 yellow, 0.1 red and 0.1 blue). All four dehydration temperatures did not seem to affect the total acid content of the product. The levels of starch gelatinization in the dehydrated products ranged from 0.4 to 2.0%.

Taste panel scores were used to assess the acceptability of 'banku' and 'akasa' made from the dehydrated products. The results show that dehydration above 120°C produces burnt flavour in the cooked products. Dehydration temperatures of 60°C, 100°C and 120°C are suitable for the production of acceptable products.

## INTRODUCTION

Dietary uses of maize in Ghana have been reported by Whitby (1968) and Dovlo (1970). Maize is consumed in Ghana mainly in a fermented form. The maize is made into a dough which is spontaneously fermented for 3-4 days before it is used. Fermented maize dough forms the basis of various staple foods of which "banku" "kenkey" and "akasa" are the most important.

The type of fermentation has been identified as lactic acid in nature (Christian, 1970 and Indeh, 1974) Maize dough at an advanced stage of fermentation has been shown by Christian to contain a mixed population of lactic acid bacteria and yeasts. The major fermentation product has been identified as lactic acid with traces of acetic acid.

Work done on the nutrient content of fermented maize dough has shown that there is an increase in thiamine content during fermentation stage of the dough preparation (Indeh and Muller, 1973).

After the desired level of fermentation is attained the product has to be used within a day or two after which time it starts to develop unpleasant aroma and excessive sourness. This has been a common problem with the storage of fermented maize dough.

This paper reports on work done on the dehydration of fermented maize dough as a means of improving the shelf-life of the product. Schweigart and de Wit (1960) found that drying of mahewu (a Bantu fermented beverage made from maize) at temperatures below 45°C can lead to enzymic changes resulting in the product becoming rancid. This rancidity was found especially with spontaneously soured mahewu.

In this work, spontaneously fermented maize dough was dehydrated at temperatures 130°C, 120°C, 100°C and 60°C for various periods using a hot air tray drier. Physical, chemical and organoleptic characteristics of the dehydrated products were determined and compared with those of undehydrated product (control) for acceptability.

## MATERIALS AND METHODS

Fermented maize dough was prepared using the traditional method (Andah and Muller, 1973). It was then put in air tight containers and stored at 10°C and used for the following experiments. The dough had a moisture content of 46.9 per cent and an acid content of 708mg NaOH/100g.

### Dehydration of fermented maize dough

Batches of one kilo of dough were divided into four equal parts, spread unto four trays and dried at temperatures 60°C, 100°C, 120°C and 130°C for various lengths of time in a laboratory hot air drier. The dehydrated samples were cooled in a dessicator and stored at 5°C in air tight brown bottles for subsequent work.

### Moisture and acid content

The moisture and total titratable acid content of dehydrated samples were determined using A.C.A.C. (1970) methods.

### Level of gelatinization of dehydrated samples

All dehydrated samples were tested for their level of ~~gelatinization~~ gelatinization (Wooton, Weeden and Munk, 1971). In this method, the degree of galatini-zation is defined as the ratio of gelatinized starch to total starch in a product. It is calculated from spectrophotometric measurements of the starch-iodine complex formed in an aqueous suspension of samples before and after complete solubilisation of the starch by alkali.

### Colour grading of dehydrated maize dough

Effect of dehydration on the colour of reconstituted products was estimated using a Lovibond Tintometer with a sample of undehydrated dough as the control. Each dehydrated sample was reconstituted with tap water into the same consistency as fresh maize dough before the colour was graded.

### Taste Panel Assesement of dehydrated maize dough

Samples of dehydrated fermented maize dough (6% moisture content) and undehydrated corn dough (control) were used in preparation of porridge (akasa) and 'banku'. Eight judges were used as the panel, Scoring method used were the Preference Test (Larmond, 1977). Specified characteristics used in the sensory evaluation of samples were the taste, aroma, appearance texture and overall acceptability.

For each characteristic, the judge was asked to record his degree of likeness for the coded sample.

A 4 point Hedonic scale used was as follows:-

<u>Rating</u>	<u>Numerical value</u>
Like very much	4
Like	3
Fair	2
Dislike	1

The rating assigned by the judges were converted to their numerical values. The results were subjected to statistical analysis to determine if there was a significant difference between the various treatments and the control.

Standardised method for Preparation of Akasa

100gm of sample flour was mixed with 250ml of cold water. This was stirred into 1000ml of boiling water and allowed to boil 5 minutes. 50g sugar (sucrose) was added to sweeten the cooked akasa.

For preparation of control, 250gm fermented corndough was mixed with 250 ml of cold water. This was stirred into 1000ml boiling water. 50g sugar was added as sweetening agent.

Standardised method for Preparation of Banku

300ml of water with 1 level teaspoon of salt was heated on fire. While boiling, 1120gm of flour was gradually added with stirring until the flour and the water was mixed into a smooth paste. It was cooked with stirring for 12 mins. until desired consistency.

For the control, 100gm of fermented corn dough was stirred into 160ml boiling water. It was cooked for 20 minutes.

These cooked samples were served warm to the judges in separate booths.

TABLE 1

MOISTURE CONTENT, TOTAL ACID CONTENT AND  
LEVEL OF GELATINIZATION OF DEHYDRATED MAIZE DOUGH

Dehydration Temperature (°C)	Dehydration Time (Mins)	Moisture Content (percent)	Titrateable acids mg. NaOH/100mg	Level of gelatinization (percent)
60	108	11.7	704	0.4
	300	8.5	704	0.6
	420	6.9	696	0.6
	480	6.2*	696	0.7
100	60	9.0	704	0.7
	90	6.0*	700	0.8
	120	4.5	700	0.9
	150	3.7	692	0.9
120	60	9.5	704	1.2
	70	7.5	700	1.4
	80	5.7*	696	1.6
	90	5.0	690	1.7
130	40	13.8	700	1.2
	50	8.6	700	1.4
	60	5.9*	692	1.8
	70	4.6	684	2.0
Fresh maize dough (control)		46.9	708	

\* Samples with moisture content of about 6% were used for taste panel tests.

COLOUR GRADING OF DEHYDRATED CORN DOUGH  
WITH THE LOUVERMORE HYPOTOMETER

Dehydration Temperature (°C)	Dehydration Time (Mins.)	Yellow	Red	Blue
60	180	0.5	0.3	-
	300	0.5	0.3	-
	420	0.5	0.3	-
	480	0.5	0.3	-
100	60	0.7	0.7	-
	90	0.7	0.7	0.1
	120	0.7	0.7	0.1
	150	0.7	0.8	0.2
120	60	0.9	0.7	0.1
	70	0.9	0.7	0.1
	80	1.0	0.7	0.1
	90	1.5	0.8	0.1
130	40	0.8	0.4	-
	50	0.8	0.4	-
	60	1.2	0.3	0.1
	70	2.0	1.0	0.1
Undehydrated dough (control)		0.6	0.2	

Specified Characteristic	Source of Variation	Degree of Freedom	Sum of Squares	Mean square	Variation Ratio Calculated	Variation Ratio at 5% Tabular
Taste	Sample	4	15.35	3.75	3.65	2.71
	Judges	7	3.98	0.57	0.55	
	Error	28	32.65	1.16		
	Total	39	51.96			
Appearance	Samples	4	16.85	4.21	5.65	2.71
	Judges	7	3.38	0.48		
	Error	28	20.75	0.74		
	Total	39				
Aroma	Samples	4	25.60	6.4	6.27	2.71
	Judges	7	2.78	0.39	0.38	
	Error	28	28.65	1.02		
	Total	39	57.03	7.81		
Over all Acceptability	Samples	4	25.50	6.40	8.77	2.71
	Judges	7	3.18	0.45	0.61	
	Error	28	20.82	0.74		
	TOTAL	39	49.90	7.68		



TABLE 4

TUKEY'S TEST FOR DIFFERENCES AMONG SAMPLES OF  
DEHYDRATED MAIZE DOUGH COOKED INTO AKASA

Sensory Characteristics	SAMPLE SCORE					Standard Error	Least Significant Differences	Differences between samples and control				Remarks
	60°C	100°C	120°C	130°C	Control			60°C	100°C	120°C	130°C	
Taste	16	21	29	15	20	0.38	1.56	0.50	0.12	1.17	0.63	
Aroma	15	25	31	13	19	0.36	1.49	0.51	0.50	1.50	0.75	burnt aroma in burnt 130°C
Appearance	28	23	19	14	27	0.30	1.23	0.13	0.49	0.99	1.62*	130°C dark, significantly different
Overall Acceptability	13	21	31	14	30	0.30	1.23	0.38	0.12	0.45	1.38*	130°C Significantly different from control

TABLE 5  
ANALYSIS OF VARIANCE TABLE FOR BANKU

Specified Sensory Characteristic	Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	Variation Ratio At 5%	
					Calculated	Tabular
Taste	Samples	4	13.15	3.29	5.22	2.71
	Judges	7	7.10	1.01	1.66	
	Error	28	17.65	0.63		
	Total	39	39.90	5.01		
Appearance	Samples	4	9.35	2.34	1.95	2.71
	Judges	7	3.98	0.57	0.48	
	Error	28	33.65	1.20		
	Total	39	46.98	4.11		
Aroma	Samples	4	18.01	4.65	5.47	2.71
	Judges	7	5.58	0.79	0.93	
	Error	28	23.90	0.89		
	Total	39	48.08	6.29		
Texture	Sample	4	10.01	2.50	3.79	2.71
	Judges	7	9.98	1.40	2.12	
	Error	28	18.39	0.66		
	Total	39	33.38	4.56		
Overall Acceptability	Samples	4	18.90	4.73	4.98	2.71
	Judges	7	6.30	0.90		
	Error	28	26.70	0.95		
	Total	39	51.90	6.58		

TABLE 6

TUKEY'S TEST FOR DIFFERENCES AMONG  
SAMPLES - BANKU

Characteristic	60°C	100°C	120°C	130°C	Control	Standard Error	Least Significant Difference	Differences between samples control				Remarks
								60°C	100°C	120°C	130°C	
Taste	19	22	22	11	24	0.28	1.15*	0.62	0.25	0.25	1.53*	Taste of 130°C is different from control
Aroma	19	24	24	10	24	0.33	1.36	0.62	0.00	0.00	1.75	Aroma of 130°C different from control
Appearance	24	20	25	15	25	0.39	1.60	0.12	0.62	0.00	1.25	
Texture	24	25	22	16	28	0.29	1.19	0.5	0.38	0.75	1.50	Texture of 130°C different from control
Overall Acceptability	21	25	21	10	25	0.35	1.44	1.40	0.00	0.55	1.87	

## RESULTS AND DISCUSSION

### Dehydration, total acid, and starch gelatinization

Results of dehydration experiments indicate that the rate of loss of moisture is initially faster but this slows down with time.

All four temperatures do not affect the total acid content of the product as shown in Table I. This is explained by the fact that the main fermentation product is lactic acid which is non-volatile (Andeh, 1974).

Starch gelatinization in all dehydrated samples was negligible (0.4 - 2.0%).

### Colour Grading

Browning occurred in samples dehydrated at 12°C and 130°C whilst the low temperatures of 60°C and 100°C did not adversely affect the colour. (Table 2).

### Taste Panel

#### (1) Akasa

Table 3 shows the analysis of variance of scores for samples cooked into akasa. For all characteristics there is a significant difference between samples since the calculated variation ratio exceed the tabular ratio at 5% level. There is however no difference between the mean score of judges.

Since there is a significant difference among the samples the ones that are different from the control were determined using Tukey's Range Method for multiple comparison and the results are summarised in Table 4. Akasa from the sample dehydrated at 130°C has appearance and acceptability significantly different from the control. Judges comments also indicate a burnt flavour in the same sample. On the other hand, akasa from samples dehydrated at 60°C, 100°C and 120°C were found not different from the control.

#### (2) Banku

For all the characteristics specified, except appearance, the results in Table 5 indicate significant differences between samples.

The sample dehydrated at 130°C stands out as the only one different from the control in taste, aroma and texture (Table 6).

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