A STUDY OF THE NUTRIENT CONTENT OF THE VARIETIES OF BREAD IN COMMON USE IN SOUTH AFRICA

J. H. LOMBARD, M.Sc., J. BRANDT, B.Sc. AND A. S. WEHMEYER, M.Sc., *National Nutrition Research Institute, Council for Scientific and Industrial Research, Pretoria*

The available data concerning the nutrient content of South African bread are rather limited. The present study was undertaken as part of a project of which the aim is to determine the nutrient contents of South African foodstuffs and use the data obtained in the compilation of tables giving the composition of South African foods.

The study entailed the chemical analysis of the 4 types of bread normally produced by bakeries in Pretoria, viz: white, brown, wholewheat and special wholewheat loaves.

MATERIAL AND METHODS

Sampling and Preparation of Samples for Analysis

It was not practicable to conduct the analysis of samples of each type of bread from each bakery simultaneously. Therefore, a statistically-acceptable sampling scheme which permitted the drawing of sample loaves in convenient quantities was devised and adopted. The products of 6 bakeries which manufacture about 99% of the total amount of bread baked commercially in Pretoria were sampled. The samples were drawn approximately weekly in such a way that over a period of 3 - 4 months 3 - 4 samples of each type of bread were drawn from each bakery, where this was possible. (Only 3 of the 6 bakeries produced special wholewheat bread.) Only 2-lb. loaves were sampled and the total number of samples taken was 66, which consisted of 21 white, 21 brown, 15 wholewheat and 9 special wholewheat loaves.

On arrival at the laboratory the crusts at both ends of each loaf were cut off and discarded and the loaves were cut in half. One half of each loaf was treated as follows:

(*1*) Three slices (2 from the end and 1 from the middle) were cut off. The slices were manually reduced to fine crumbs which were well mixed and portions were weighed off immediately for the vitamin determinations.

(*2*) The moisture content of the bread was determined without delay on two portions of 2 G of 3 slices obtained and treated as under (*1*). The remainder of each half-loaf (including the crumbs remaining from (*1*) and (*2*) above) was dried at 40°C, pulverized in a hammer mill and used to provide the samples for the remaining analyses.

Since it had been decided to determine the effects of toasting on the nutrient content of the bread, 3 slices of bread were cut from the remaining half of each loaf, as in the case of the untoasted bread, and the slices were toasted in an ordinary home electric toaster. These slices were treated as in (*1*) above, to provide portions for vitamin determinations, while a further 3 slices were toasted and treated as in (*2*) above, to provide portions for moisture determinations. The remainder of each half-loaf was sliced, toasted and reduced to crumbs which were mixed with the balance of the crumbs obtained earlier and not used for vitamin or moisture determinations. The crumbs were dried at 40°C, pulverized in a hammer mill, and used to provide material for the remaining required analyses.

Analytical Investigation of the Samples

The study entailed the determination of the following nutrients: protein, fat, ash, fibre, calcium, magnesium, phosphorus, iron, thiamine, riboflavin and nicotinic acid. Proven standard methods of analysis used in the Food Chemistry Division of the NNRI were employed for the determinations. Details of the methods used may be obtained from the NNRI on request.

The moisture contents of the loaves as received were obtained by determining the loss of weight of a sample of 2 G dried in a vacuum oven at 75°C and 200 mm.Hg to constant weight. The Brabender rapid moisture tester was employed in the estimation of the moisture contents of the dried samples.

The percentage carbohydrate contents of the samples were estimated by deducting the percentage contents of moisture, fat, protein, fibre and ash from 100. In the case of white bread, protein values were obtained by using a factor of 5·7 ($5{\cdot}7 \times N$), while for the bread prepared from high-extraction flours a factor of 5·83 ($5{\cdot}83 \times N$) was used.

The calorific values were calculated on the assumption that 1 G of either carbohydrates or proteins yields 4 large calories of energy when ingested. The corresponding figure adopted for fat was 9 large calories per gram.

RESULTS

As previously indicated, 66 loaves comprising 4 different types of bread were drawn from 6 different bakeries and their nutrient contents were determined. The results obtained are given in Table I.

It can be seen from Table I that the calcium contents of the different loaves varied considerably. This was probably due to the variable use of calcium acetate in the prevention of 'rope'. The remaining nutrient contents show no significant anomalies.

The average nutrient contents of the various types of bread and the range of variation of these contents are given in Table II.

It may be noted from Table II that the magnesium, phosphorus, riboflavin and nicotinic acid contents of white bread are lower than those of bread prepared from high-extraction flours.

The effects of toasting on the nutrient contents of the different types of bread may be determined by reference to Table III which gives the nutrient values of untoasted and toasted bread (on a moisture-free basis).

The degree to which bread is normally toasted is not constant, being dependent on the taste of the individual consumer. The bread used for the determinations given in Table III was toasted, as far as possible, to a uniform golden-brown colour. Since the protein content of toasted bread was considered as being nutritionally of no great importance, the effect of toasting on the amino acid contents of bread proteins was not determined. Table III shows that the thiamine and nicotinic acid contents of toasted bread are lower than those of fresh bread. On the other hand, the values for riboflavin appear to indicate that the concentration of this nutrient is increased by toasting. It is felt that this increase is most unlikely to have been actual since riboflavin is sensitive to heat. It is possible that toasting resulted in the formation of a material which fluoresces in the same region of the spectrum as does riboflavin and which was not removed or compensated for by the method employed. This matter requires further investigation.

The proportions of the daily human requirements of nutrients contained in one slice (25 G) of bread are given in Table IV. The daily requirements on which this Table is based were taken from the information given by Engel.[1] In the cases of magnesium and phosphorus no reliable information about the daily human requirement is available. As a result no estimate of magnesium supply

TABLE I. NUTRIENT CONTENTS OF FOUR KINDS OF BREAD MANUFACTURED BY 6 BAKERIES

Bakery (code)	Bread type	No. of loaves analysed	a or b	G/100 G						mg./100 G						
				Moisture	Protein	Fat	Ash	Fibre	Carbohydrate	Ca	Mg	P	Fe	Thiamine	Riboflavin	Nicotinic acid
1	White ..	3	a	35·6	8·0	2·0	1·7	0·3	52·4	45	35	97	1·8	0·18	0·060	0·8
	,, ..	—	b	33·7—37·1	7·7—8·3	2·0—2·1	1·6—1·7	0·2—0·3	50·5—54·8	30—50	33—37	90—101	1·5—1·9	0·15—0·21	0·058—0·062	0·5—1·0
	Brown ..	4	a	37·5	8·0	2·2	2·1	1·0	49·2	43	61	144	2·5	0·20	0·083	2·0
	,, ..	—	b	35·7—39·0	7·9—8·2	2·1—2·4	1·7—2·9	0·9—1·3	46·2—51·7	35—51	57—65	136—155	2·3—2·7	0·19—0·23	0·076—0·087	1·8—2·2
	Wholewheat	3	a	37·1	7·9	2·3	1·9	1·1	49·7	40	59	153	2·6	0·21	0·076	2·3
	,, ..	—	b	33·6—39·4	7·7—8·2	2·2—2·3	1·8—2·1	1·1—1·2	46·8—53·6	21—63	55—61	133—167	2·4—2·7	0·19—0·22	0·071—0·086	2·2—2·4
	Spec. wholewheat ..	3	a	37·5	7·6	2·3	2·2	1·0	49·4	38	60	160	2·5	0·22	0·072	2·2
		—	b	33·5—39·7	7·1—8·2	2·2—2·3	2·0—2·3	0·9—1·1	46·4—54·3	23—48	55—69	151—176	2·3—2·7	0·21—0·23	0·068—0·079	1·9—2·6
2	White ..	4	a	38·1	7·8	2·0	1·6	0·3	50·2	76	32	99	1·6	0·17	0·052	0·86
	,, ..	—	b	37·2—39·2	7·5—8·1	1·9—2·1	1·6—1·7	0·2—0·3	48·6—51·6	73—80	31—34	93—106	1·3—2·0	0·16—0·18	0·050—0·053	0·77—0·94
	Brown ..	3	a	39·3	7·7	2·2	1·9	0·9	48·0	84	56	151	2·2	0·18	0·072	1·7
	,, ..	—	b	37·4—40·9	7·4—8·0	1·9—2·5	1·8—1·9	0·9—1·0	45·7—50·6	77—88	55—56	150—152	1·9—2·6	0·17—0·19	0·067—0·078	1·2—2·1
	Wholewheat	4	a	36·6	7·9	2·5	1·8	1·1	50·1	74	62	166	2·3	0·20	0·078	1·9
	,,	—	b	34·0—39·8	7·3—8·4	2·0—2·8	1·7—1·9	1·0—1·3	45·8—54·0	65—81	55—66	154—172	2·0—2·6	0·19—0·21	0·073—0·089	1·4—2·4
	Spec. wholewheat ..	2	a	39·2	7·4	2·7	1·8	1·0	47·9	77	60	154	2·7	0·18	0·081	2·3
		—	b	36·6—40·8	7·2—7·6	2·6—2·8	1·8—1·8	1·0—1·0	46·0—50·8	72—83	56—63	149—159	2·1—3·3	0·17—0·18	0·079—0·083	2·2—2·4
3	White ..	4	a	36·8	7·6	2·0	1·9	0·2	51·5	43	32	100	1·8	0·16	0·057	0·89
	,, ..	—	b	35·0—39·2	7·3—7·8	1·8—2·1	1·9—1·9	0·2—0·3	48·7—53·8	37—48	30—35	97—107	1·5—2·7	0·14—0·18	0·049—0·064	0·78—0·98
	Brown ..	3	a	38·4	7·6	2·2	2·0	1·0	48·8	47	58	150	2·7	0·18	0·078	2·13
	,, ..	—	b	37·8—39·5	7·4—7·8	2·0—2·4	1·9—2·1	0·9—1·0	47·2—50·0	43—51	55—61	147—155	2·5—2·9	0·17—0·19	0·075—0·079	2·1—2·2
	Wholewheat	3	a	37·0	7·6	2·2	2·1	1·1	50·0	47	60	161	4·0	0·2	0·076	2·0
	,,	—	b	36·8—37·2	7·5—7·7	1·8—2·4	2·0—2·2	1·1—1·2	49·3—50·8	45—49	57—64	158—163	2·7—4·7	0·2—0·3	0·071—0·080	1·4—2·5
	Spec. wholewheat ..	3	a	41·2	7·3	2·2	2·2	1·0	46·1	60	60	164	2·2	0·17	0·071	2·0
		—	b	38·4—43·8	7·0—7·6	2·1—2·4	2·1—2·4	1·0—1·1	42·7—49·4	55—68	55—64	151—185	2·1—2·3	0·16—0·18	0·06 —0·079	1·9—2·1
4	White ..	3	a	38·5	7·0	2·4	1·8	0·3	50·0	39	34	97	1·8	0·17	0·056	0·9
	,, ..	—	b	37·7—39·3	6·8—7·2	2·2—2·8	1·8—1·8	0·2—0·3	48·6—51·3	32—45	33—35	95—99	1·3—2·3	0·15—0·19	0·050—0·061	0·7—1·0
	Brown ..	4	a	40·1	7·6	2·8	2·0	0·9	46·6	48	61	155	2·8	0·22	0·075	1·8
	,, ..	—	b	38·4—42·5	7·0—8·2	2·5—3·0	1·9—2·0	0·9—0·9	43·4—49·3	25—78	53—67	143—164	2·4—3·3	0·21—0·24	0·067—0·087	1·7—1·9
	Wholewheat	3	a	37·3	8·1	2·6	2·1	1·1	48·8	45	66	168	3·2	0·23	0·080	2·4
	,, ..	—	b	35·9—39·3	7·5—8·5	2·4—2·7	1·8—2·6	1·0—1·2	45·7—51·4	25—61	63—69	157—179	2·7—3·9	0·22—0·23	0·073—0·084	2·2—2·5
5	White ..	3	a	37·5	7·6	2·1	1·8	0·2	50·8	28	34	99	1·6	0·15	0·052	0·9
	,, ..	—	b	36·7—38·7	7·3—8·0	1·9—2·3	1·8—1·9	0·2—0·3	48·8—52·1	13—56	33—35	97—101	1·3—2·1	0·14—0·17	0·051—0·055	0·8—1·1
	Brown ..	4	a	39·6	7·6	2·1	1·9	1·0	47·8	40	58	148	2·2	0·16	0·065	1·8
	,, ..	—	b	36·5—42·2	7·0—8·1	2·0—2·3	1·8—2·2	1·0—1·1	44·1—51·7	21—66	51—62	139—155	2·1—2·5	0·15—0·18	0·060—0·069	1·7—1·9
6	White ..	4	a	38·2	7·7	2·2	1·8	0·2	49·9	17	38	101	1·5	0·17	0·052	0·9
	,, ..	—	b	37·7—39·7	7·5—8·2	2·1—2·2	1·7—1·8	0·2—0·3	47·8—50·8	16—20	37—39	91—109	1·4—1·6	0·15—0·19	0·046—0·059	0·9—1·0
	Brown ..	3	a	38·2	8·3	2·6	2·0	1·0	47·9	21	61	156	2·5	0·22	0·082	2·2
	,, ..	—	b	37·7—38·9	7·8—8·9	2·4—2·7	2·0—2·0	0·9—1·1	46·4—49·2	19—23	59—64	153—159	2·3—2·7	0·19—0·24	0·077—0·091	2·1—2·3
	Wholewheat	2	a	36·0	8·1	2·6	2·1	1·2	50·0	41	67	168	2·5	0·22	0·092	2·3
	,, ..	—	b	35·4—36·7	8·0—8·2	2·3—3·8	2·1—2·2	1·2—1·2	48·9—51·0	26—56	66—68	167—170	2·5—2·5	0·21—0·22	0·091—0·092	1·8—2·9
	Spec. wholewheat ..	1	—	37·3	7·9	2·4	2·0	1·0	49·4	65	71	161	2·9	0·21	0·081	2·3

a = Average values; b = Limits of variation

TABLE II. AVERAGE NUTRIENT CONTENTS OF 4 DIFFERENT KINDS OF BREAD

Bread type	No. of loaves	a or b	Calories /100 G	G/100 G						mg/100 G						
				Moisture	Protein	Fat	Ash	Fibre	Carbohydrate	Ca	Mg	P	Fe	Thiamine	Riboflavin	Nicotinic acid
White ..	21	a	252·5	37·4	7·6	2·1	1·8	0·3	50·8	41	34	99	1·7	0·17	0·055	0·87
		b	—	33·7—39·7	6·8—8·3	1·8—2·8	1·6—1·9	0·2—0·3	47·0—55·9	13—80	30—39	90—109	1·3—2·7	0·14—0·21	0·046—0·064	0·49—1·09
Brown ..	21	a	244·8	38·8	7·8	2·4	2·0	1·0	48·0	47	59	151	2·4	0·19	0·076	1·94
		b	—	35·7—42·2	7·0—8·9	1·9—3·0	1·7—2·9	0·9—1·3	41·7—52·8	19—88	51—67	136—164	1·9—3·3	0·15—0·24	0·060—0·091	1·16—2·31
Wholewheat	15	a	252·4	36·8	7·9	2·4	2·0	1·1	49·8	49	63	161	2·9	0·21	0·080	2·19
		b	—	33·6—39·8	7·3—8·5	1·8—2·8	1·7—2·6	1·0—1·3	45·0—54·6	21—81	55—69	133—179	2·0—4·7	0·19—0·23	0·071—0·072	1·36—2·86
Special wholewheat	9	a	244·4	38·8	7·6	2·4	2·1	1·0	48·1	60	63	160	2·6	0·20	0·076	2·22
		b	—	33·5—43·8	7·0—8·2	2·1—2·8	1·8—2·4	0·9—1·1	41·7—54·7	23—83	55—71	149—185	2·1—3·3	0·16—0·23	0·062—0·083	1·89—2·60

a = Average values; b = Limits of variation

TABLE III. NUTRIENT CONTENTS OF UNTOASTED AND TOASTED BREAD (ON A MOISTURE-FREE BASIS)

Bread type	a, b or c	G/100 G										mg/100 G													
		Protein		Fat		Ash		Fibre		Carbohydrate		Calcium		Magnesium		Phosphorus		Iron		Thiamine		Riboflavin		Nicotinic acid	
		V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R
White ..	a	12·4	12·4	3·3	3·1	2·8	2·8	0·4	0·5	81·1	81·2	59	59	55	57	163	164	2·5	2·7	0·25	0·23	0·091	0·120	1·6	1·4
	b	13·2	13·2	3·5	3·4	3·0	3·0	0·4	0·5	79·9	79·9	118	118	63	71	175	177	3·7	3·8	0·22	0·20	0·086	0·097	1·7	1·7
	c	10·9	11·3	2·8	2·8	2·5	2·5	0·4	0·4	83·4	83·0	23	25	52	54	152	151	2·0	2·2	0·30	0·26	0·097	0·151	1·4	1·3
Brown ..	a	12·8	13·1	3·6	3·9	3·1	3·1	1·6	1·7	78·9	78·2	62	64	101	103	248	250	3·9	3·8	0·33	0·30	0·122	0·156	3·4	3·2
	b	13·3	14·0	4·9	4·8	3·2	3·3	1·7	1·7	76·9	76·2	130	142	108	107	266	266	4·4	4·1	0·39	0·37	0·141	0·184	3·7	3·5
	c	12·3	12·5	3·2	3·1	2·8	2·7	1·5	1·7	80·2	80·0	34	33	95	99	219	226	3·5	3·3	0·24	0·27	0·101	0·131	3·1	2·9
Wholewheat	a	12·5	13·1	3·5	3·6	3·1	3·0	1·9	1·9	79·0	78·4	59	59	102	103	263	265	4·0	4·1	0·33	0·30	0·123	0·137	3·9	3·5
	b	13·3	13·7	3·7	3·8	3·5	3·2	2·0	2·0	77·5	77·3	111	113	104	108	271	277	4·5	4·5	0·36	0·33	0·145	0·147	4·5	3·9
	c	11·9	12·0	3·1	3·3	2·8	2·7	1·8	1·8	80·4	80·2	34	35	99	99	257	257	3·1	3·6	0·30	0·26	0·113	0·128	3·7	3·1
Special wholewheat	a	12·2	12·2	3·8	3·8	3·3	3·3	1·7	1·8	79·0	78·9	89	91	101	100	258	258	3·8	3·6	0·31	0·29	0·113	0·142	3·9	3·2
	b	12·3	12·3	4·4	4·3	3·6	3·4	1·9	2·0	77·8	78·0	140	140	104	107	264	267	4·0	3·7	0·34	0·33	0·140	0·150	4·1	3·8
	c	12·1	12·2	3·4	3·2	3·0	3·0	1·6	1·7	79·9	79·9	34	39	95	93	252	252	3·5	3·5	0·29	0·24	0·106	0·134	3·6	2·8

V = Untoasted bread values; R = Toasted bread values; a = Average values; b = Maximum values; c = Minimum values.

TABLE IV. AVERAGE PERCENTAGE OF THE DAILY REQUIREMENTS OF NUTRIENTS SUPPLIED BY ONE SLICE OF BREAD (25 G)

One slice of	Calories		Protein		Calcium		Phosphorus		Iron		Thiamine		Riboflavin		Nicotinic Acid	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman
White bread	2·2	3·0	2·7	3·3	1·2	1·2	4·2	4·2	4·0	2·7	3·3	5·0	·82	1·1	1·1	1·6
Brown bread	2·1	2·9	2·8	3·4	1·5	1·5	6·3	6·3	6·0	4·0	4·2	6·2	1·1	1·5	2·5	3·4
Wholewheat bread	2·2	3·0	2·8	3·4	1·5	1·5	6·7	6·7	7·0	4·7	4·2	6·2	1·2	1·5	2·9	3·9
Spec. wholewheat bread ..	2·1	2·9	2·7	3·3	1·8	1·8	6·7	6·7	6·5	4·3	4·2	6·2	1·1	1·5	2·9	3·9

is included in Table IV, and the value of the supply of phosphorus has been estimated on the basis suggested by Du Bruyn of NNRI (private communication), viz. that the desirable ratio of Ca to P is 0·84 : 1.

The results show that the nutritive value of white bread in respect of mineral content, thiamine and nicotinic acid is lower than that of bread made from high-extraction flours.

Conclusions

The conclusions drawn from the results of this study are:

1. The calcium contents of different samples of bread tested varied considerably.
2. Each of 6 bakeries supplied the same kind of bread with no significant differences in nutrient value apart from calcium content.
3. The thiamine and nicotinic acid contents of bread are reduced by toasting.

It is believed that the nutrient values obtained for bread manufactured in Pretoria would be representative of those of bread produced in other urban areas of the Republic.

SUMMARY

A study was undertaken to determine and compare the nutrient contents of various types of bread produced in the urban area of Pretoria. Over a period of 3 - 4 months, 66 loaves of bread consisting of white, brown, wholewheat and special wholewheat bread were drawn from 6 bakeries which manufacture about 99% of the bread made in Pretoria. The moisture, protein, ash, fibre, fat, carbohydrate, calcium, magnesium, iron, phosphorus, thiamine, riboflavin and nicotinic acid contents were determined. The calorific values of the samples were calculated from the data obtained.

The results of this study indicate that there is no significant difference in the composition of the same type of bread produced by the 6 bakeries from which samples were drawn.

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