Food Chemistry 45 (1992) 323–326

Chemical composition and nutritive value of retail white bread in Zaria, Nigeria

A. A. Abede, G. A. Ayoko* & K. Singh‡

Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria

(Received 25 July 1991; revised version received and accepted 10 February 1992)

The chemical composition of twelve samples of white bread sold in Zaria, Nigeria, has been investigated and the results discussed in terms of nutritive values. The samples are rich in iron, phosphorus, sodium, moisture and fat, moderate in protein and low in calcium. Apart from salt and sugar, there are no wide variations in their constituents. The overall composition of the breads is comparable with those from France, USA, Italy, Japan, Poland, Sudan, Pakistan, Egypt and the UK.

INTRODUCTION

Bread is fundamentally foamed gluten (Kent, 1983) and it is made by baking a dough which has wheaten flour, water, yeast and salt as its main ingredients. Other ingredients that may be added to the dough include fat, sugar, soya flours or other cereals, vitamins, milk and fruits. The bread thus obtained may be eaten without further processing. It is usually neatly packed and convenient to carry about and its low fat content makes it the main ingredient in 'slimming' diets (Kent, 1983). In addition, bread is palatable and its relatively high starch and gluten contents cause a low level of blood cholesterol to be associated with its consumption (Kent, 1983). As a result of these advantages, bread is widely used for snacks, part of the courses of meals and for breakfast. For instance, in the UK, it supplied up to 17·1% energy, 17·4% protein, 25·5% vitamin B_1 and 24·3% iron in the diet in 1979 (Kent, 1983).

Kilbry (1965) suggested that wheat bread came to Nigeria as a result of the return of freed Afro-Brazilian slaves after 1835. Today, it has attained such importance in the Nigerian diet that when it was not in the market recently, several reports and articles about its scarcity filled the Nigerian Dailies (Dibia, 1986). Unfortunately, while the compositions and nutritive values of breads sold in many other countries (Watt & Merill, 1963; Trzebska-Jeske, 1968; Knight *et al.*, 1973; Mustafa, 1973; Omura *et al.*, 1974; Khan & Eggum, 1978; Tebekhia & Toma, 1979) have been investigated, those of the breads sold in Nigeria in general and Zaria in particular, have not been fully investigated, as far as we are aware. The present work was therefore undertaken to provide data on the chemical composition of white bread which might be used to assess and improve the nutritive value of the bread sold in Nigeria. For the purpose of comparison with the compositions of bread from other countries, the bread samples analysed in this study are subsequently loosely referred to as 'the Nigerian breads'.

* Present Address: Department of Chemistry, University of Papua New Guinea, PO Box 320, University, Papua New Guinea.

‡ To whom correspondence should be addressed.

MATERIALS AND METHODS

Materials

Twelve samples of unenriched white bread, baked with flour supplied by various mills in Nigeria were used in the investigations. The bread samples (Agoro, City, Omas United, Nasara, Temidre, Yoka, Dan Mama, Hamza, Vita, Omas United (rolls), Arewa and Oluwalose) were obtained fresh from bakeries in and around Zaria, Kaduna State of Nigeria between January 1980 and May, 1986. In order to allow analysis to be performed 'blind' the bread samples were coded immediately after purchase. (The code corresponding to each type of bread may be obtained from the authors on request.)

Analytical methods

Each loaf or roll of bread was removed from its polyethylene cover, weighed, sliced into portions 2–3 mm thick and dried on paper at room temperature to constant weight for determination of the equilibrium moisture content. The dried samples of the breads were then ground in a mortar to pass through a 0·6 mm sieve and stored in tight-fitting screw-cap bottles in desiccators at 5°C until required for chemical analyses.

The total solids, ash, iron, calcium, chloride, phosphorus and protein contents were determined by the methods of the Associations of Official Analytical Chemists (AOAC, 1980). The fat content was determined as described by Pearson (Pearson, 1976) and the sugar by Luff-Schoorl method (Luff-Schoorl, 1974). Flame photometry using a Gallenkamp Flame Analyser PH.500 was used to measure the sodium and potassium contents. The carbohydrate was estimated by difference and values obtained multiplied by a factor 0·97 to give the available carbohydrate contents using Frazer and Holmes (1956) method.

All assays were conducted on ten rolls or loaves of each of the twelve samples of bread and determinations were repeated at least three times. The relative standard deviation (%) in the nutrient composition of individual loaves was in the range 0·70–1·90. Values given in Table 1 and 2 for each constituent are means of three or more close determinations.

RESULTS AND DISCUSSION

Table 1 shows the proximate compositions of the bread samples: Table 2 summarizes their mineral contents and Table 3 presents data on white bread from other countries. (The countries were selected to reflect data from North America, Asia, Europe and other parts of Africa.)

It is evident from Table 1 that the equilibrium moisture contents of the bread samples range from 21 to 28%, while the total moisture contents (estimated indirectly from the total solid contents of the fresh loaf) lie in the range 24–45%. Thus apart from samples 11 and 12, the true moisture contents of the bread samples are broadly similar to or higher than the moisture contents of those from other countries (Table 3).

At the level of 3·2–4·3%, the fat contents are much higher than those for bread samples from Italy, Japan, Poland, Pakistan and the UK, but similar to values of those from France and the USA (Table 3). Strong flour such as the one used in the manufacture of the analysed

Table 1. Proximate composition of retail white breads in Zaria, Nigeria

Sample	Total solids	Constituents[a]				Total sugar	Available[c] carbohydrate
		Moisture	Ash	Fat	Protein		
1	53·90	26·92[b] (43·44)[d]	1·29	3·66	8·73	3·25	39·41
2	60·60	22·65[b] (35·68)	1·72	3·72	8·65	8·08	40·89
3	52·85	28·00[b] (43·85)	1·17	3·30	8·45	6·80	35·34
4	58·80	22·90 (37·43)	1·19	3·77	8·30	8·67	39·42
5	52·40	27·40[b] (44·07)	1·18	3·53	8·25	6·90	34·99
6	58·42	23·20[b] (37·77)	1·28	3·81	9·16	4·08	42·58
7	57·91	23·86[b] (38·29)	1·75	3·80	9·00	4·48	41·40
8	53·23	27·10[b] (43·48)	1·51	3·29	8·47	4·25	37·82
9	60·42	21·90[b] (35·98)	1·45	3·60	8·66	8·96	40·11
10	52·15	28·30[b] (44·30)	1·35	3·55	8·30	3·84	37·50
11	68·52	27·46[b] (27·22)	2·14	4·26	9·30	1·10	54·30
12	70·50	25·00[b] (25·37)	2·10	4·13	8·80	1·00	56·84

[a] Mean of at least three close determinations.
[b] Equilibrium moisture content.
[c] Estimate.
[d] Figures in parentheses are total moisture contents (moisture lost on air drying + moisture in air dried sample, as determined by oven drying).

Table 2. Mineral composition of white breads sold in Zaria, Nigeria

Sample	Mineral[a] (mg/100 g)					
	Fe	Ca	P	Na	K	Cl
1	4·4	20·5	1461	1279	174	41
2	2·9	23·5	1520	2064	252	94
3	2·2	21·0	1804	1858	174	52
4	2·4	19·4	1705	1864	182	42
5	2·8	15·5	1891	1357	188	29
6	4·2	22·5	1498	1596	192	61
7	3·1	23·3	1720	2760	179	50
8	2·8	23·3	1720	2760	179	50
9	3·7	15·7	1368	1520	278	80
10	2·3	20·2	1835	1856	182	52
11	2·6	23·5	1850	1958	195	58
12	2·5	21·0	1648	1878	189	97

[a] Mean of three determinations.

sample contains *ca* 0·7% fat (Chamberlain *et al.*, 1966). It thus seems that considerable amounts of fats (2·5–3·6%) were used in baking the Nigerian bread, probably to make tender and easy-to-slice loaves.

The bread samples contain 8·2–9·3% protein which is comparable with values for white bread from France, USA, Italy, Japan, Poland and the UK. Protein gives bread correct strength and texture (Kent, 1983) and it is predictable that, all other factors being equal, the textures of the bread samples from Nigeria and these countries are similar. Interestingly, the protein contents of the Nigerian bread and grains such as wheat (9·3%) and millet (9·0%) are comparable, but are lower than those of maize (10·7%), rice (12·5%), guinea corn (15·0%) and soya beans (40·8%), but significantly higher than those of other Nigerian staple foods like white and sweet potatoes (*ca* 5·3%), cassava flour (gari) (1·0%), white yam tuber (4·2%) and plantain (3·0%) (Oyenuga, 1968). There are moves to produce bread on a commercial scale from maize flour enriched with soya beans in Nigeria. Such a bread would be rich in protein and should provide a cheap source of this nutrient, especially to vegetarians and people who cannot afford meat regularly.

The total solids were found to be *ca* 52–71%. Hence the total carbohydrate, estimated by difference, is probably *ca* 35–59% and available carbohydrate *ca* 34–57%. Using these figures and those for the protein and fat contents of the bread samples, their food energies were evaluated to be *ca* 830–1212 kg/100 g by the method of Knight *et al.* 1973). This shows that only samples, 2, 9, 11 and 12 have food energies comparable with equal quantities of bread from Japan (1120–1538 kJ), Poland (1120 kJ) and the UK (1066 kJ) (see Table 3 for appropriate references). Since the fat and protein contents of bread from those countries are generally lower than their Nigerian counterparts, the low carbohydrate content of the latter appears to be responsible for their comparatively low food energies. (Other staple foods in Nigeria such as white yam, cassava flour (Gari), guinea corn and rice have *ca* 1470 kJ/100 g food

Table 3. Chemical composition of white breads from various countries

Country	Proximate composition (%)				Mineral Composition (mg/100 g)					Ref.
	Moisture	Protein	Fat	Ash	Ca	P	Fe	Na	K	
France	30·6	9·1	3·0	1·9	43·0	85·0	0·7	580·0	90·0	*a*
USA	35·0	9·0	3·8	2·0	96·0	102·0	0·7	495·0	121·0	*a*
Italy	31·8	9·1	0·8	1·9	17·0	77·0	0·7	585·0	74·0	*a*
Japan	33·6–36·7	8·0	1·0	—	—	—	—	—	—	*b*
Poland	—[h]	8·3	1·6	1·5	—	—	—	—	—	*c*
Sudan	25·3[i]	12·9	—	1·6	—	—	—	—	—	*d*
Pakistan	—	11·4	2·1	1·4	33·0	175·5	5·5	—	—	*e*
Egypt	13·9[i]	9·6–23·7	—	2·0	22·6–70·6	176·4–375·4	4·2–9·6	—	—	*f*
UK	38·5	8·4	1·7	1·9	100·0	—	1·8	540·0	100·0	*g*

[a] Watt & Merill (1963).
[b] Omura *et al.* (1974).
[c] Trzebska-Jeske *et al.* (1968).
[d] Mustafa (1973).
[e] Khan & Eggum (1978).
[f] Tebekhia & Toma (1979).
[g] Knight *et al.* (1973).
[h] Not quoted.
[i] Equilibrium moisture content.

energy (Oyenuga, 1968) and are better sources of energy than bread.)

The bread samples showed very wide variations (1–9%) in their sugar contents. It is possible that since sugar does not affect the texture of bread drastically, bakers use any amount of this ingredient as long as the taste is acceptable. For example, samples 3 and 10 are products of the same baker, but the sugar content of one is nearly twice that of the other. At their present levels, the sugar contents of the samples of bread are not detrimental to health.

With the exception of samples 11 and 12, the ash contents (*ca* 1·2–2·1%) are generally lower than those from western countries (Table 3), suggesting that the latter are possibly richer in mineral composition. (The extraction rate of the Nigerian white flour is 72–73% Abede (1981) compared to 74% for white flour from the UK (Kent, 1983).) Only calcium, phosphorus, iron, sodium, potassium and chloride ions were determined in this study. The results (Table 2), like those from other countries (Table 3), indicate that sodium, potassium and phosphorus are the most abundant minerals in bread. In addition, the Nigerian bread samples are rich in iron (2·5–4·2 mg/100 g) and are in this respect similar to Pakistani and Egyptian white bread. It is possible that the high iron content of water in Nigeria is responsible for the correspondingly high levels of iron in the Nigerian bread (Udoh *et al.*, 1987).

Compared with those from France, USA, Egypt and the UK, the calcium contents (*ca* 16–24 mg/100 g) of the analysed bread samples are generally low. In keeping with this, the calcium/phosphorus ratios of all the samples are grossly imbalanced in relation to the ordinary dietary requirement of these nutrients (Food and Nutrition Board, 1968). It is therefore recommended that bread sold in Zaria should be enriched with calcium carbonate (creta praeparata, chalk) or edible bone meal as is the practice in the UK, the USA and Canada (Kent, 1983).

Like sugar, the chloride content of the bread varied widely from 29 to 97 mg/100 g. In Nigeria, there is no legal standard about the salt content of bread and bakers add any quantity of salt as long as the taste remains pleasant. This practice must be regulated by law as high intakes of sodium chloride may be detrimental to health while too low concentrations would produce sticky doughs (Kent, 1983). Further analysis of other types of white bread sold throughout the country merit investigation in order to enable the food and drug administration in Nigeria to set and enforce uniform acceptable composition of breads across the country.

ACKNOWLEDGEMENTS

We thank the University Board of Research, Ahmadu Bello University, Zaria for financial support (to K.S.) and the Head of Department of Chemistry for providing facilities for the work.

REFERENCES

Abede, A. A. (1981). MSc Thesis, Ahmadu Bello University, Zaria, Nigeria.

AOAC (1980). *Official Methods of Analysis* 12th edn. Association of Official Analytical Chemists, Washington, DC, pp. 211–32.

Chamberlain, N., Collins, T. H., Elton, G. A. H., Hollingsworth, E. F., Lisle, D. B. & Payne, P. R. (1966). Studies on the composition of food 2. Comparison of the nutrient content of bread made conventionally and by the Chorleywood Bread Process. *Brit. J. Nutr.*, **20**, 747–55.

Dibia, E. (1986). End to flour crisis not in sight. *The Guardian*, ed. L. Bonuola. Lagos, Vol. 3, No. 1026, p. 4.

Food and Nutrition Board, Natural Academy of Sciences, (1968). National Research Council, Washington DC, NAS Publication No. 1694.

Frazer, J. R. & Holmes, D. C. (1956). The proximate analysis of wheat flour carbohydrates II. The analysis of the carbohydrate fractions of different flour types. *J. Sci. Food Agric.*, **7**, 589–94.

Kent, N. L. (1983). *Technology of Cereals: An Introduction for Students of Food Science and Agriculture*, 3rd edn. Pergamon Press, Oxford and New York, pp. 121–52.

Khan, M. A. A. & Eggum, B. O. (1978). Effect of baking on the nutritive value of Pakistani bread. *J. Sci. Food Agric.*, **29**, 1069–75.

Kilbry, P. (1965). *African Enterprise: The Nigerian Bread Industry*. Hoover Institution Studies, No. 8, Stanford University Press, Stanford, CA.

Knight, R. A., Christic, A. A., Orton, C. R. & Robertson, J. (1973). Studies on the composition of food 4. Comparison of the nutrient content of retail white bread made conventionally and by Chorleywood Bread Process. *Brit. J. Nutr.*, **30**, 181–8.

Luff-Schoorl (1974). Luff-Schoorl Method. *Official Journal of European Community*, p. 38.

Mustafa, A. M. I. (1973). Production of bread from composite flour. *Sud. J. Food Sci. Technol.*, **5**, 41–5.

Omura, H., Takata, M., Ishida, H. & Aramaki, T. (1974). Examination of some staple processed foods in the market of Fukuoka Prefecture I, White Bread. *Science Bulletin of the Faculty of Agriculture, Kyushu University*, **28**, 145–9.

Oyenuga, (1968). *Nigeria's Foods and Feedstuffs: their Chemistry and Nutritive Value*. Ibadan University Press, Ibadan.

Pearson, D. (1976). *The Chemical Analysis of Foods*, 7th edn. Churchill Livingstone, London and New York.

Tebekhia, M. M. & Toma, B. B. (1979). Chemical composition of various types of Egyptian breads. *Nutrition Reports International*, **19**, 377–82.

Trzebska-Jeske, I. & Battnik, J. (1968, 1969). Nutritive value of Polish bread 6. Energy contents of three types of commercial bread produced in Warsaw in 1964. *ROCZ. Pangstwowego Zakt. Hig.*, **19**, 221–30; *Nutrition Abstracts and Review*, **30**, 2358.

Udoh, A. P., Omenesa, H. Z. & Singh, K. (1987). Determination of some quality assessing parameters for drinking water in Zaria. *Nigerian Journal of Scientific Research*, **1**, 53–6.

Watt, B. K. & Merrill, A. L. (1963). *Composition of Foods*. USDA Agricultural Handbook No. 8, US Government Printing Office, Washington, DC.