NUTRITIONAL AND MINERAL COMPOSITION OF WHITE BREAD IN NATIONAL CAPITAL DISTRICT (NCD), PAPUA NEW GUINEA (PNG)

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ABSTRACT

The nutritive and mineral composition of ten samples of white bread sold in N.C.D., PNG, was investigated. The samples are rich in sodium, potassium and phosphorus but low in iron and calcium. The moisture, fat, ash and protein show a fair distribution thus making the bread samples comparable to those from overseas countries.

KEY WORDS: *baking, vitamins, proximate analysis, ash, fat, protein, enzyme.*

INTRODUCTION

Bread is basically foamed gluten (Kent, 1983) and it is made by baking a dough which has wheaten, flour water, yeast and salt as its main ingredients. Nutritive value is increased by the addition of fat, milk, sugar, soya flour, vitamins, fruits and nuts. Since bread is usually eaten along with milk, butter, cheese etc, that makes bread valuable for dietary purpose.

Bread making is an art which has been practised from earliest known times. Commercial production of bread in PNG and other third world countries is carried out by the Chorley Wood process (Bennion, 1967). This process is based on the principle of mechanical dough ripening and was developed by the British Baking Industry. Bread is thought to have come to PNG by the early missionaries and since then it has become popular in many parts of PNG. It is however unfortunate that there is no known reference on the mineral composition and nutritive value of breads sold in PNG. The present work was therefore undertaken to provide data on the chemical compositin of white bread which might be used by Nutrition Specialist in PNG to assess and improve the quality of bread sold in PNG. The bread samples investigated are referred to as "Papua New Guinean breads" for the purpose of comparison with composition of breads from other countries.

MATERIALS AND METHOD

Ten samples of white bread, baked with flour and supplied by various bakeries in NCD were used in the investigation. The bread sample were obtained in polyethylene bags fresh from various retail outlets in NCD between August, 1995 and September, 1996.

The ingredient labels were surveyed and coded (Table 1) and half of each loaf was removed from its polyethylene cover, weighed, covered and dried on paper at room temperature at constant weight for determination of equilibrium moisture content. The dried samples of bread were then ground in a mortar to pass through 0.6 mm sieve and stored in airtight screw cap bottles in desiccator until required for chemical analysis.

The total solids, ash, iron, calcium, chloride, phosphorus, and protein contents were determined by the method of Association of Official Analytical Chemists (AOAC, 1990). The fat content was determined as described by (Pearson, 1976). Sodium and potassium were determined by Flame Photo-metry. The carbohydrate was estimated using Frazer and Holmes (1967) method.

All assays and determinants were repeated four times on the ten samples and the average of each determinant is given in Tables 2 and 3. The relative standard deviation (%) in the nutrient composition of each sample was in the range 0.5 - 1.60.

RESULTS AND DISCUSSION

The nutritional composition of white bread in PNG is quite consistently distributed throughout the ten samples. Table 4 shows proximate nutritional constituents of bread from other regions of the world (Abede *et al.* 1992).

The equilibrium moisture contents according to Table 1 lie in the range of 15-39% while the total moisture content is from 30-50%. The bread moisture content

Table 1: **RETAIL WHITE BREAD WITH TYPICAL INCREDIENTS IN NCD, PAPUA NEW GUINEA**

Sample	Retail name	Typical ingredients
1	Premium White	Enriched wheat flour, shortening, yeast, sugar, salt, milk, water added
2	JJ's Island	Flour, salt, shortening, sugar, yeast, emulsifier, improver, water added
3	Bilas White	Bread making flour, yeast, salt, vegetable oil, emulsifier, soya flour, enzyme (α-amylase), preservative, vitamins (thiamin), water added.
4	Butter Cup Tasty	Bread making flour, gluten, yeast, salt, vegetable oil, emulsifier, preservative, enzyme (α-amylase), water added.
5	Island Fresh	Enriched wheat flour, sugar, shortening, dry milk, active dry yeast, salt.
6	Sunfield Super Toast	Bakers flour, shortening, salt, bakers yeast, emulsifier, enzyme (α-amylase), preservative, vitamin (thiamin), water added.
7	Bilas Toasty	Break baking flour, yeast, salt, vegetable oil, animal fat, gluten soya flour, emulsifier, enzyme (α-amylase), preservative, vitamin (thiamin), water added.
8	G. Bake Bun	Wheat flour, shortening, salt, sugar, yeast, poweder milk, eggs, flabouring.
9	Fresh Kai	Bread making flour, yeast, salt, veg. oil, animal fat, gluten, soya flour, emulsifier, enzyme (α-amylase), preservative, vitamin (thiamin), water added.
10	Buyers Choice	Bakers flour, shortening, salt, bakers yeast, emulsifer, sugar, vitamin, minerals, milk and water added.

Table 2: **PROXIMATE COMPOSITION OF RETAIL WHITE BREAD IN NCD, PAPUA NEW GUINEA**

	total	moisture		constituents			carbohydrates
sample	solids	air dry	indirect method	ash	fat	protein	
1	62.9	219.0^{x} (302.2)^{y}	24.1a (24.3)^{b}	1.7	1.2	10.5	54.9
2	56.5	202.8^{x} (404.6)^{y}	32.5^{a} (33.5)^{b}	1.7	1.8	10.4	42.1
3	52.6	195.6^{x} (256.6)^{y}	37.1^{a} (37.4)^{b}	1.4	1.4	09.4	39.3
4	61.0	204.6^{x} (300.2)^{y}	38.9^{a} (39.0)^{b}	1.8	0.9	10.6	36.0
5	64.9	200.7^{x} (271.9)^{y}	35.0^{a} (35.3)^{b}	1.8	0.8	09.2	47.3
6	69.5	210.7^{x} (246.8)^{y}	33.6^{a} (33.9)^{b}	1.6	0.9	10.7	45.5
7	53.8	177.2^{x} (288.3)^{y}	30.2^{a} (30.5)^{b}	1.7	1.7	09.6	40.4
8	59.1	266.8^{x} (346.8)^{y}	32.7^{a} (33.0)^{b}	1.7	1.8	08.7	32.3
9	64.4	226.8^{x} (332.3)^{y}	32.3^{a} (32.7)^{b}	1.6	1.1	09.9	41.2
10	64.2	217.4^{x} (271.3)^{y}	33.7^{a} (34.1)^{b}	1.7	1.2	10.3	44.6

* - average of 4 determinations
a - air dry sample before oven drying
b - is the total moisture content (moisture lost in air dry + moisture in air dried sample, as determined by oven drying)
y - weight of half loaf
x - weight of half loaf after air drying (equilibrium moisture content is calculated as percentage)

Table 3: **MINERAL CONTENTS OF WHITE BREAD SOLD IN NCD, PAPUA NEW GUINEA.** (Mean of 4 determinants).

Sample		Mineral (mg/100 g)				
	Fe	Ca	P	Cl	K	Na
1	0.2	14.7	1050	47	230	1520
2	0.2	14.2	510	49	225	1470
3	0.2	14.3	910	45	230	1480
4	0.3	19.4	890	36	225	1450
5	0.5	12.5	575	42	225	1470
6	1.6	18.7	700	49	240	1810
7	1.4	15.3	1000	61	230	1490
8	2.3	21.3	720	54	205	1350
9	2.1	18.3	970	54	215	1655
10	1.7	21.6	1090	54	230	1730

of other countries (Table 4) are between 13-39%. This is very similar to the values obtained by the Air dry method. Egypt has the lowest equilibrium moisture of 13% while sample 6 of PNG bread has a lowest of 15%. The high relative humidity in these parts of the regions causes bread to stale rapidly.

The fat content level ranges between 0.8-1.8% which is comparable with those of Italy, Japan, Poland and Britain. USA has the highest fat content of 3.8% followed by Nigeria with 3.7%. This is associated with the level of fat as ingredient, probably to extend shelf life and tenderize crust (Klans *et al.* 1991). Samples 3 and 4 have vegetable oil added while 7 and 9 both have vegetable oil and animal fat added.

The protein content in PNG bread is between 8.7-10.7%. Egypt is the only country that falls within these range. Otherwise, the values are comparable to France, USA and Italy. Flour provides most of the protein content of bread around 11-13%. Bread sample 3 and 9 added soya flour which is responsible for most of its protein content since soya beans contain

Table 4: **CHEMICAL COMPOSITION OF WHITE BREADS FROM VARIOUS COUNTRIES[T]**

Country	Proximate Composition (%)					Mineral Composition (mg/100 g)					
	Moisture	Protein	Fat	Ash	Carbo dydrate	Ca	P	Fe	Na	K	Cl
France	30.6	9.1	3.0	1.9	-	43.0	85.0	0.7	580	90	-
USA	35.0	9.0	3.8	2.0	-	96.0	102.0	0.7	495	121	-
Italy	31.8	9.1	0.8	1.9	-	17.0	77.0	0.7	585	74	-
Japan	33.6	8.0	1.0	-	-	-	-	-	-	-	-
Poland	-	8.3	1.6	1.6	-	-	-	-	-	-	-
Sudan	25.3[y]	12.9	-	1.6	-	-	-	-	-	-	-
Pakistan	-	11.4	1.2	1.4	-	33.0	175.5	5.5	-	-	-
Egypt	13.9[y]	9.6	-	2.0	-	22.6	176.4	4.2	-	-	-
	23.7	13.8	-	3.6	-	70.6	375.4	9.6	-	-	-
UK	38.5	8.4	1.7	1.9	-	100.0	-	1.8	540	100	-
Nigeria[f]	31.42	8.7	3.7	1.5	41.7	20.8	1668	3.0	1896	197	59

T Abede *et al.* 1992
Y equilibrium moisture content
- not quoted
f Average of 12 samples (Abede *et al.* 1992)

40.8% protein (Abede *et al.* 1992). Gluten is fundamentally protein and water (Kent, 1983) and when present in bread also gives a high protein content as added to samples 4, 7 and 9.

The total carbohydrate level is around 32-55% and is comparable with those from Nigeria around 35-59%. A low carbohydrate content is responsible for low food energies, however, carbohydrate content in PNG bread gives food energies similar to those from Nigeria, Japan, Poland and UK (Abede *et al.* 1992). Sugar is added to samples 1, 2, 5, 8 and 10 (Table 1) and contributes significantly to high content level. Sugar acts as food for growing yeast during fermentation process and is used as a sweetener in bread. The browning of bread when baked is due to caramelisation (sugar and heat) (Kent, 1983).

The total solids were found to be between 52.6-69.5% and the ash content is around 1.4-1.8%. The breads from Sudan, Poland, Pakistan and Nigeria fall within this range. This implies that the mineral composition is comparable with these countries. USA and Egypt have higher mineral content than other countries.

The level of iron of PNG bread samples is around 0.2-2.3 mg/100 g and is comparable to France, USA, Italy and Britain. Sudan, Pakistan and Egypt have a high level of iron content. This is probably due to enrichment as most iron is added to bread for nutritional purpose. Traces of iron are found in enzymes and vitamins which are added to all the samples except for 1, 2 and 5.

The results (Table 3) indicate that the most abundant bulk minerals in PNG breads are sodium, potassium, phosphorus and calcium. Nigeria has the most abundant sodium, potassium and phosphorus values. Other countries show consistent values comparable with PNG bread. Calcium level of PNG bread is around 12-19 mg/100 g. All other countries show high results except Italy with 17 mg/100 g and Nigeria with 20.8 mg/100 g. Bread in Britain, USA and Canada is enriched with addition of calcium carbonate or edible bone meal (Kent, 1983 & Abede *et al.* 1992). It shows that PNG bread samples 1, 5, 8 and 10 (Table 1), contain enriched flour and milk and add to total calcium level in PNG bread samples.

The chlorine content in PNG bread was found to be around 36-61 mg/100 g. That is comparable with those from Nigeria. Most chlorine came from addition of salt and chlorine from treated water system. Salt has no limit and can be added in any quantity to help control fermentation, toughens dough and extends required dough development (Kent, 1983). Most often the amount of flour used for baking determines the amount of salt input. Salt is considered as a flavour enhancer and can be added depending on the craftsmen as long as taste remains pleasant.

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