

Quality Assessment of Wheat Bread Baked in Bahir Dar City, Ethiopia

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HIGHLIGHTS

- Moisture, total ash, and crude fat of the bread samples were ranged from 12.16 to 28.38%, 0.77 to 2.33%, and 0.41 to 1.87%, respectively.
- Dietary fiber, crude protein, and carbohydrate of the bread samples were ranged from 0.13 to 1.36%, 8.01 to 14.34%, and 54.83 to 76.99%, respectively.
- Calcium, iron, and zinc levels were ranged from 11.1 to 22.0, 1.2 to 12.5, and 0.7 to 2.1 mg/100 g, respectively.
- Some wheat bread sampled from Bahir Dar City did not meet the bread quality standards.

Article type

Short communication

Keywords

Bread
Food Quality
Food Analysis
Ethiopia

Article history

Received: 18 Jan 2018

Revised: 23 Feb 2018

Accepted: 29 Mar 2018

ABSTRACT

Background: So far, there is paucity of information about quality of breads available in Ethiopian bakeries. The aim of this study was to assess the proximate composition and some selected nutrient composition of wheat breads baked in Bahir Dar City, Ethiopia.

Methods: Totally, 54 fresh loaves of wheat bread were randomly taken from 18 bakeries (three from each one) in Bahir Dar City, Ethiopia. Then, the proximate composition and mineral contents of the samples were determined.

Results: The results of the analysis revealed that the proximate compositions were ranged from 12.16 to 28.38%, 0.77 to 2.33%, 0.41 to 1.87%, 0.13 to 1.36%, 8.01 to 14.34%, and 54.83 to 76.99% for moisture, total ash, crude fat, dietary fiber, crude protein, and carbohydrate, respectively. In addition, the level of calcium, iron, and zinc were ranged from 11.1 to 22.0, 1.2 to 12.5, and 0.7 to 2.1 mg/100 g, respectively.

Conclusion: Some wheat bread sampled from Bahir Dar City did not meet the bread quality standards parameters. So, it is necessary to design supervision mechanisms to enforce the local bakeries to select the suitable ingredients and produce bread with the required composition.

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Introduction

Wheat bread is the staple food in most regions of the world. Depending its type and origin, the bread provides approximately more than 10% of individual's daily intake of protein, vitamins (e.g. thiamine, niacin), minerals (e.g. iron, zinc, copper), and required fiber (Al-Mussalil and Al-Gahri, 2009; Ayub et al., 2003; O'Connor, 2012; Odedeji et al., 2014). Otherwise, the nutritive val-

ues of the bread are improved by adding additives and/or blend the wheat flour with other flour type. Several reports have been made in the world to evaluate the nutritional quality of breads and compared with their national or international guidelines/standards. However, in Ethiopia in general and in Bahir Dar in particular, there is no available baseline data regarding quality assessment of the produced wheat bread. The legal framework in Ethiopia governs bakeries to ensure only the moisture

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To cite: Eshetu M., Atlabachew M., Abebe A. (2018). Quality assessment of wheat bread baked in Bahir Dar City, Ethiopia. *Journal of Food Quality and Hazards Control*. 5: 77-80.

and fiber content. Thus, this paper was aimed to assess the proximate composition and some selected nutrient composition of wheat bread baked in Bahir Dar, Ethiopia and to compare it with some international guidelines. In addition, the findings of this study may provide adequate information on the nutritive composition of bread and it may ensure the dietary safety of individuals in the city.

Materials and methods

Collection of bread samples

Bahir Dar, the capital city of Amhara region, Ethiopia which involves nine sub-cities has 132 licensed bakeries. Totally, 54 fresh loaves of wheat breads were randomly taken from 18 bakeries (three from each one) in the city. The breads were immediately dried, ground, and powdered for further investigation. In order to get freshly samples, all the breads were collected in the morning (between 7:00 to 8:00 am) and sampling was conducted within one h. Mean values of the three samples were taken for all measurements. For each sample, triplicate analysis was carried out.

Determination of moisture content

All the breads were dried in the oven at 100 °C for 3 h following the standard method (Nielsen, 2010). Then, the moisture content was estimated by following formula:

$$\text{Moisture content (\%)} = \frac{(\text{weight of fresh sample} - \text{weight of dry sample}) \times 100}{\text{weight of fresh sample}}$$

Determination of ash content

The dried and powdered (2 g) sample was ashed in the muffle furnace at a given temperature for a set period of time following the method reported by Nielsen (2010). The ash content was calculated by comparing the mass of the ash with mass of the original sample.

Determination of oil content

About 6 g of each sample was weighed and extracted in hexane using soxhlet extractor (Nielsen, 2010). It was extracted with 300 ml hexane at its boiling point for 6 h. After extraction, the oil was concentrated under vacuum by rotary evaporator. Then, the concentrated oil was transferred to small beaker and the solvent was completely evaporated under the oven at 50 °C. Finally, the percentage composition of the oil was calculated with respect to the dry mass of the sample.

Determination of fiber content

Weende's method (James, 2013) was used for determination of fiber content. Two g of each sample was

weighed using analytical balance and put in to a 250 ml round bottom flask. Then, 200 ml of 1.25% H₂SO₄ was added and the obtained mixture was then boiled under reflux for about 30 min. The solution was filtered with Whatman filter paper, the residue was rinsed thoroughly with hot water until it was no more acidic when tested using universal pH indicator. The residue was transferred into a 250 ml beaker and 200 ml of 1.25% NaOH was added and boiled for 30 min in a digestion apparatus after which it was filtered and rinsed with distilled water until the filtrate was neutral when tested with universal pH indicator. The residue was transferred into a crucible and then placed in the electric oven at 100 °C for 8 h to dry. It was then removed and placed in desiccators to cool before weighing. The crude fiber content was determined using equation indicated below:

$$\text{Crude fiber (g/100g)} = \frac{[(w_1 - w_2) \times 100]}{w_3}$$

Where: w₁=weight of (crucible+sample) after drying; w₂=weight of (crucible+sample) after ashing; w₃=weight of fresh sample.

Determination of protein content

Kjeldahl method was used to determine the crude protein (Nielsen, 2010). Three g of each sample, 5 g of catalyst (a mixture of CuSO₄ and K₂SO₄) and 15 ml of concentrated H₂SO₄ were taken for digestion. Following the reported procedure, the digested sample was distilled and then titrated against 0.1 N hydrochloric acid. The volume of 0.1 N HCl required to neutralize the liberated ammonia was recorded and then the total nitrogen was calculated using the following formula.

$$\text{N (\%)} = \frac{\text{ml 0.1 NHCl (sample)} - \text{ml 0.1 N HCl (blank)} \times 0.0014 \times \text{N HCl} \times 100}{\text{weight of sample}}$$

Protein (g/100 g)=%total nitrogen x appropriate nitrogen conversion factor

Determination of crude carbohydrate

Total carbohydrate content of each sample was determined by subtraction of the tested parameters from 100% using the following formula (Offor et al., 2014).

$$\text{Total carbohydrates (\%)} = 100 - (\text{protein\%} + \text{fiber\%} + \text{oil\%} + \text{ash\%} + \text{moisture\%})$$

Determination of mineral content

Mineral contents of bread were determined after digestion using dry ashing method following the method reported by Soylak et al. (2004). To the digested filtrate, one ml of 0.1 M LaCl₃ solution was added to each sample to avoid interference. For each element, calibration curves were constructed using standard concentrations of each element.

Results and discussion

The moisture, ash, oil, fiber, protein, carbohydrate, iron, zinc, and calcium content of bread samples are indicated in Table 1. Moisture content of the breads from different bakeries was ranged from 12.16 to 28.38%. Compared with the Ethiopian Standard (2005), the breads investigated in this study were found to contain lower moisture content and hence they did not meet the bread quality standards in this respect. The same was true for oil content (ranging from 0.41 to 1.87%) and fiber content (ranging from 0.18 to 1.36%) which were below the Ethiopian Standard (2005). The lower oil content in the studied bread might be due to the fact that the germ, which contains fat in wheat was removed during milling or/and the original wheat sample was of low quality in terms of fat content. The ash content of the bread samples of this survey was ranged from 0.77 to 2.33% which is comparable with the similar work in Tanzania (Mongi et al., 2011) and Bulgaria (Isserliyska et al., 2001).

Although Ethiopia has no established standard for protein in bread, the protein content of our samples

(8.01-14.34%) were within the range of the standards set by other countries (Ayub et al., 2003; Begum et al., 2014; SON, 2004). The same trend was seen for carbohydrate content in the breads, which was ranged from 54.83 to 76.99%. Like carbohydrate and protein, the studied bread samples were rich in calcium (11.05-22.0 mg/100 g), iron (1.16-12.52 mg/100 g), and zinc (0.7-2.08 mg/100 g). These results are comparable with the data reported in Bulgaria (Isserliyska et al., 2001) but lower than data reported from Poland (Winiarska-Mieczan and Kwiecień, 2011). Several factors such as origin of the raw material, presence of preservative, dough conditioners and texture enhancers, sanitary conditions and ways of baking might be responsible for such variations (Paulley et al., 1998). Looking at the mineral data in Table 1, consumption of bread alone could not satisfy the daily need of the individual's mineral elements (calcium, iron, and zinc) (NRC, 1989). Therefore, fortification of these nutrients or blending the wheat flour with other calcium, iron, as well as zinc rich cereal flours are important to satisfy the individual's recommended daily need.

Table 1: The mean levels of proximate composition and minerals in the bread samples from 18 commercial bread bakeries in Bahir Dar City, Ethiopia

Bakery No.	Moisture (%)	Ash (%)	Oil (%)	Fiber (%)	Protein (%)	Carbohydrate (%)	Iron (mg/100 g)	Zinc (mg/100 g)	Calcium (mg/100 g)
1	18.30±2.89	1.17±0.02	1.24±0.40	0.30±0.18	10.60±0.67	68.37	12.52±2.51	1.24±0.25	14.44±2.89
2	16.80±2.36	2.33±0.05	1.45±0.45	0.31±0.15	12.75±1.03	66.29	7.96±1.59	0.66±0.13	11.05±2.21
3	17.91±2.89	1.00±0.02	0.96±0.26	0.38±0.29	9.52±0.51	70.22	4.74±0.95	0.96±0.19	17.44±3.49
4	12.28±2.59	1.50±0.03	0.68±0.16	0.54±0.25	8.01±0.37	76.99	7.90±1.59	1.14±0.28	15.50±3.10
5	22.85±2.50	1.17±0.02	0.67±0.13	0.85±0.24	13.47±0.64	60.99	4.82±0.96	1.08±0.22	16.05±3.21
6	20.00±1.52	0.83±0.02	0.76±0.14	0.33±0.05	11.25±0.27	66.83	3.48±0.70	0.86±0.17	14.37±2.90
7	22.06±7.64	1.50±0.03	0.73±0.15	0.35±0.16	10.24±0.18	65.12	3.96±0.80	1.12±0.22	17.52±3.50
8	18.18±5.00	1.33±0.03	0.85±0.23	0.36±0.27	9.30±0.37	69.97	5.52±1.10	1.08±0.20	16.25±3.25
9	15.88±5.77	1.00±0.02	0.51±0.12	0.33±0.29	11.46±0.10	70.84	6.26±1.25	1.12±0.22	18.21±3.64
10	17.74±5.00	2.33±0.05	0.67±0.09	1.30±1.03	12.83±0.47	65.15	4.08±0.81	1.16±0.24	17.91±3.60
11	17.81±2.59	2.17±0.04	1.00±0.14	0.18±0.10	14.34±0.48	64.60	2.84±0.57	0.98±0.19	18.82±3.76
12	23.64±2.89	1.83±0.04	0.62±0.41	0.86±0.50	13.84±0.30	59.22	5.34±1.07	0.84±0.17	21.32±4.26
13	28.38±2.02	2.17±0.04	1.50±0.16	1.04±0.81	12.11±0.44	54.83	10.32±2.06	2.08±0.42	17.24±3.45
14	16.87±5.00	0.77±0.02	0.41±0.07	0.04±0.10	11.03±0.27	70.79	12.48±2.50	2.02±0.40	18.45±3.70
15	12.16±2.89	1.20±0.02	1.13±0.31	0.46±0.33	11.74±0.31	73.35	1.16±0.23	0.70±0.14	12.70±2.54
16	14.50±10.4	1.33±0.03	1.45±0.33	0.33±0.01	12.60±0.99	69.78	3.36±0.67	0.78±0.16	14.61±3.00
17	25.74±10.4	1.17±0.02	1.87±0.51	0.77±0.50	13.16±0.33	57.30	4.66±0.93	1.10±0.22	22.00±4.40
18	23.72±11.8	1.67±0.03	1.16±0.32	1.36±1.11	10.03±0.53	62.06	4.74±0.95	1.02±0.20	21.43±4.30

Conclusion

Some wheat bread sampled from Bahir Dar City did not meet the bread quality standards. So, it is necessary to design supervision mechanisms to enforce the local bakeries to select the suitable ingredients and produce bread with the required composition.

Author contributions

M.A. designed the study; M.E. conducted the experimental work; M.E., M.A., and A.A. analyzed the data and wrote the manuscript. All authors revised and approved the final manuscript.

Conflicts of interest

There is no conflict of interest.

Acknowledgements

We are thankful to the Department of Chemistry, Bahir Dar University, Ethiopia for the financial support; and also School of Food and Chemical Engineering, Bahir Dar University, Ethiopia, for providing the laboratory facilities. This research was ethically approved by the proposal review committee members of the Department of Chemistry, Bahir Dar University, Ethiopia.

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