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Full Length Research Paper

Determination of Heavy Metals and Nutritional Composition of Wheat (Trictum aestivum) in Dodola Woreda, Ethiopia

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Abstract

This study investigates the concentration of selected heavy metals and the nutritional composition of wheat in Dodola Woreda, Ethiopia. The wheat samples were dried and digested using nitric acid and perchloric acid. The digestion procedure was evaluated and showed acceptable recovery rates for the metals in the wheat samples. Metal content was determined using atomic absorption spectrometry, and the nutritional composition of the wheat was also analyzed. The results of the nutritional composition analysis showed moisture content ranging from 3.92% to 5.39%, crude fat content between 2.95% and 3.25%, crude fiber content ranging from 7.75% to 8.64%, ash content ranging from 1.03% to 1.5%, crude protein content ranging from 14.4% to 17.4%, and total carbohydrate content ranging from 64.05% to 69.69%. The Bura Adele wheat variety exhibited higher nutritional composition compared to other varieties studied. The mean concentrations of selected metals (in mg/kg dry weight basis) in the wheat samples were as follows: iron (Fe) ranged from 0.907 mg/kg to 1.367 mg/kg, zinc (Zn) ranged from 0.523 mg/kg to 1.067 mg/kg, chromium (Cr) ranged from 0.25 mg/kg to 0.897 mg/kg, copper (Cu) ranged from 0.117 mg/kg to 0.13 mg/kg, nickel (Ni) ranged from 0.136 mg/kg to 1.313 mg/kg, cadmium (Cd) ranged from 0.147 mg/kg to 0.19 mg/kg, and lead (Pb) ranged from 0.103 mg/kg to 0.25 mg/kg. Cobalt (Co) was below the method detection limit. Furthermore, a separate study was conducted on the mineral content of a similar variety of wheat, along with soil analysis from different locations.

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1. Introduction

Wheat is one of the most important crop plants in the world. It grows under a broad range of latitudes and altitudes; it is not only the most widely cultivated crop but also the most consumed food crop all over the world (Rut-Duga *et al*., 2019). Wheat is one of the most important cereals cultivated in Ethiopia. Ethiopia is the largest producer of wheat in sub- Saharan Africa (SSA), over 1.8 million hectares annually. It ranks fourth after maize, teff and sorghum both in area coverage and production (CSA, 2018). Wheat production in the country is adversely affected by low soil fertility, suboptimal use of mineral fertilizers, and synthetic pesticides accumulate or increase the presence of heavy metals in the wheat (Khan *et al*., 2018).

The total world wheat production is about 250 grams per person per day. It nourishes more people than any other type of cereal grains. Ethiopia is among the top three wheat producers in Africa, with wheat accounting for 20% of the nation's total cereal production (Alemu *et al*., 2022). The nation has more than 600 small and large flour mills, with a total production capacity of 4.2 million tons per year (Alemu *et al*., 2022). The wheat used for producing of bread, pasta, macaroni, crackers and spaghetti. Bread is an important product of wheat flour and used for daily food consumption in many parts of the world. It is an important source of carbohydrates, proteins, minerals and antioxidants.

The nutritional value of wheat is extremely important as it takes an important place among the few crop species being extensively grown as staple food sources. The importance of wheat is mainly due to the fact that its seed converted into flour, semolina, etc., which form the basic ingredients of bread and other bakery products, as well as pastas, and thus it presents the main source of nutrients to the most of the world population (Weldegebriel *et al*., 2012). The pleasant flavor, long shelf-life and unique gluten-forming characteristics of wheat products like pasta, noodles, bread, chapatti etc. make them very attractive among other cereals (Aschale *et al*., 2015). Wheat is considered as a good source of nutrient such as protein, minerals, B-group vitamins and dietary fiber although the environmental conditions can affect nutritional composition of wheat grains with its essential coating of bran, vitamins and minerals; it is an excellent health-building food and accumulation of heavy metals in wheat seed affect human health (Mekonnen *et al*., 2015).

However, the productivity of wheat in Ethiopia is low as compared to other wheat producing countries of the world because of depleted soil fertility, low levels of chemical fertilizers use, limited knowledge on time and rate of fertilizer application, absence of safe water for irrigation purpose and inappropriate crop management practices. The low mean national yield for wheat is primarily due to depleted soil fertility, low fertilizer usage, limited information available on various sources of fertilizers K, S, Zn and B and other micronutrients, and the unavailability of other improved crop management inputs such as improved seeds, diseases and weed control measures, and inaccessibility of farmers to finance, farm machinery and training. The low yield of wheat in Ethiopia (1.84 tons per ha), is primarily due to depleted soil fertility, low levels of chemical fertilizer usage and the unavailability of other modern inputs and crop management practices (Eromo, 2020).

Nowadays wastewater has threatened profitable development, quality of the environment, sustainable human livelihood, and a multitude of other public goals in many developing Asian and African regions (Bahir, 2020). Unlimited growth of the urban population, particularly in developing countries like Ethiopia, causes many pressures on water and land resources. Wastewater is increasingly being used for agricultural irrigation in urban and peri-urban areas. It is also used in distant rural areas downstream of cities (Hammed and Koki, 2016). It drives significant economic activity, particularly those of farmers, and largely affects the hydrology and water quality of natural water bodies. There are serious issues of using wastewater without ample safeguards for human health and the environment (Hassan *et al*., 2013).

Accumulation of heavy metals due to municipal discharges, agricultural discharge, long term usage of pesticides and synthetic fertilizer are being produced due to increased urbanization (Mussarat *et al*., 2021; Zia *et al*., 2017). Accumulation of heavy metals in the soil and wheat crops as well as could affect the uptake of applied fertilizers by making insoluble complexes in soil. In return, the major nutrients become unavailable to the plants and thus could result in decrease in yield (Woldetsadik *et al*., 2017) in poorly managed and fragile areas. The increasing demand for food safety stimulated the risk associated with consumption of foodstuffs contaminated by pesticides, heavy metals (Pb, Cd, Cu, Zn and Co) and/or toxins. Food safety issues and potential health risks make as one of the most serious environmental concerns (Gebregziabher and Tesfaye, 2014). Heavy metals are among the major contaminants of food supply and may be considered the major problem to our environment (Tegegne, 2015). Heavy metals may enter the human body through inhalation of dust, consumption of contaminated drinking water and consumption of food plants grown in metal contaminated soil (Hyacinthe *et al*., 2018). Heavy metals are potential environmental contaminants with the capability of causing human health problems if present in excess in the food we eat. They are given special attention throughout the world due to their toxic effects even at very low concentration (Wato and Amare, 2020).

Heavy metals are persistent and non-biodegradable, have a long biological half-lives and they could bioaccumulated through the biological chains: soil plant-food and seawater-marine organism-food leading to unwanted side effects. Hence, the presence in high amount of heavy metals in wheat crops will be represents a potential danger for human health which causes carcinogenic, neutropenia, bone abnormalities, impaired motor skills and cognitive disorders, abdominal cramps and environmental pollution due to their extreme toxicity. Although there have been several studies about the nutritional and metal composition of cereals, there is very limited study about wheat crops. The main objective of the study was to determine concentration of heavy metal) of wheat using atomic absorption spectroscopy and to investigated nutritional composition of wheat (*Trictum aestivum*). Thus, the study was intended to bridge the literature gap on the nutritional and metal concentration of wheat in Dodola woreda.

2. Materials and Methods

2.1. Description of study area

The study was conducted in Dodola woreda at Barisa, Bura Adele and Keta Berenda. Dodola is located in the West Arsi Zone of the Oromia State, southeastern Ethiopia. This woreda has a latitude and longitude of 06°59′N 39°11′E, with an elevation ranging from 2362 to 2493 meters above sea level respectively. It is 320 km far from of Addis Ababa and 75 km from the zonal capital, Shashemene (Figure 1). Barisa, Bura Adela and Keta Berenda located from Dodola town around 12 km, 16 km and 19 km respectively. The altitudinal range of the forest is from 2400 to 3712 m a.s.l. The daily temperature varies between 9 and 26 °C and the annual rainfall varies between 805 and 1260 mm (Mekonnen and Girma, 2023). According to Dodola woreda agriculture office 2021, personal communication agriculture is the main source of employment (>95%) in the woreda. The major economic activities in the woreda include the cultivation of crops, vegetables and livestock.

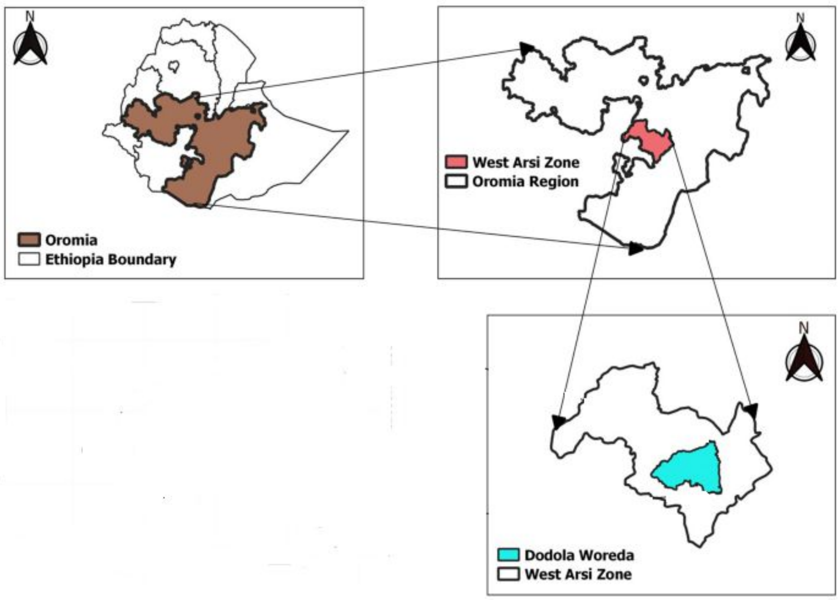

Figure 1: Map of Dodola Woreda

2.2.Chemical and Reagents

To conduct this research all chemicals were analytical reagent without further purification was used. Namely: 35.5% HCl (Analytical reagent, India), 98% H_2SO_4 (Analytical reagent, England), 68% of Nitric Acid (Analytical reagent, India), Standard solution of each metal (Analytical grade, Germany), and Distilled water.

2.3.Sample Collection and preparation

A preliminary field observation was carried out to select representative sample of wheat (1 kg) were collected from Dodola woreda (Barisa, Bura Adele and Keta Berenda). Dodola woreda was selected purposively based on the high potential production of wheat crops using irrigation water. The sample was placed in cleaned acid-washed porcelain crucibles and oven-dried at 105 °C for 24 hr in drying oven. The dried samples were then grinded into a fine powder form by using acid wash mortar and pestle, and pass through a 2.0 mm sieve. The powder sample was kept in polythene packets and ready for further analysis. Nine samples with 1 g aliquot (three from each bulk sample) were taken for final digestion.

2.4.Optimization of Working Procedure

Optimum working procedure has been developed as to urge a reliable result from an analytical experiment. Thus, to prepare a clear and colorless sample solution that was suitable for the analysis using atomic absorption spectrophotometer (AAS), different working procedures for the digestion of wheat samples were assessed using variable parameters to the mixtures of nitric acid (HNO_3) and perchloric acid ($HClO_4$) acids like volume of ratio acids mixture, digestion time and digestion temperature. The optimized procedure was selected depending upon the clearness of the ultimate digests obtained as of less digestion time, less reagent volume consumption and ease (Habte *et al*., 2020; Rezaeian *et al*., 2020). Therefore, 10 trials were tested for digestion of the wheat samples. The optimal digestion procedure was the one that needs 3 hr for complete digestion of 2 g of wheat powders, with 5 ml of 70% HNO_3 and 1 ml of 70% $HClO_4$ (Table 1) were used throughout the analysis.

Table 1: Optimization test of digestion procedures for 2 g of wheat flour samples

S/N	Reagent used	Volume ratio (ml)	Temp (°C)	Digestion time (hr)	Observations
1	HCl: $HClO_4$	4:5	200	4:25	Clear Light yellow
2	HCl: $HClO_4$	4:2	210	4:35	Deep yellow with suspension
3	HCl: $HClO_4$	3:7	210	3:1	Deep Yellow
4	HCl: $HClO_4$	10:3	210	3:15	Clear yellow
5	HCl: $HClO_4$	4:3	240	4:00	Clear Colorless
6	HCl: $HClO_4$	5:9	240	4:10	Clear Light yellow
7	HCl: $HClO_4$	3:1.5:1.7	240	4:00	Yellow
8	HCl: $HClO_4$	3:3:1.5	240	4:35	Clear light yellow
9	**HCl: $HClO_4$**	**5:1**	**300**	**3:00**	Clear & colorless (optimized)
10	**HCl: $HClO_4$**	**3:2**	**300**	**3:10**	Cloudy (suspension)

2.5.Sample Digestion

The optimized procedure was selected depending upon the clearness of the ultimate digests obtained as of less digestion time, less reagent volume consumption and ease (Gadisa *et al*., 2021). Accordingly, ten trials were tested for digestion of the wheat samples. The optimized digestion procedure was selected for complete digestion 3 hr of 2 g of wheat digestion with 5 ml of 70% HNO_3 and 1 ml of 70% $HClO_4$ (Table 1).

2.6.Preparation of standard and Calibration of the Instruments

Working standard solutions of copper (Cu), iron (Fe), zinc (Zn), cobalt (Co), nickel (Ni), chromium (Cr), lead (Pb) and cadmium (Cd) were prepared from the stock standard solutions containing 1000 ppm of element in 2 N HNO_3 (Tegegne, 2015). The instrument was calibrated using five series of calibration standard solutions and calibration of blank, measurements of elements was done using by using atomic absorption spectrophotometer (AAS). The atomic absorption spectrophotometer working conditions are given in Table 2.

Table2: Instrument operating conditions for the determination of heavy metals in wheat samples by AAS

Metal	λ(nm)	Slit width (nm)	Instrumental detection limit (mg/L)	Lamp current (mA)
Cu	324.7	0.5	0.0030	**4**
Zn	213.9	1.0	0.0010	**5**
Fe	248.3	0.2	0.0060	**5**
Co	240.7	0.2	0.0050	**7**
Ni	232.0	0.2	0.0010	**4**
Cr	357.9	0.2	0.0010	**7**
Pb	217.0	1.0	0.0010	**5**
Cd	**228.8**	**0.5**	**0.0020**	**4**

2.7.Determination of Heavy Metals

Heavy metals of each wheat sample were determined by using Atomic Absorption spectrophotometer (Alemu *et al*., 2022).

2.8.Methods of Validation

2.8.1. Methods Detection Limits (MDL)

In the present study, five blank samples were digested following an equivalent procedure as the wheat samples and each of the blank samples were analyzed for metal concentrations of Fe, Zn, Cr, Co, Cu, Ni, Pb and Cd by AAS (Gadisa *et al*., 2021). The standard deviations for each metal were calculated from the five blank triplicate measurements to work out method detection limit of the instrument. Then the method detection limit of each metal was calculated as three times the standard deviation of the blank (3 S_{blank}, n = 15) (Table 4).

2.8.2. Methods of Quantification Limits (MQL)

MQL is the lowest concentration at which a measurement is quantitatively meaningful. It is also commonly defined as 10 times the signal/noise ratio. If the noise is approximated as the standard deviation of the blank (Sblank), then MQL is 10 × Sblank, n = 15 (Chandravanshi and Adane, 2021). The results in Table 5 have revealed that both MDL and MQL values were greater than the IDL; hence, the result of analysis could be reliable.

2.9.Recovery Test

Recovery is one of the most commonly techniques used for validation of the analytical results and evaluating how much the method is acceptable for its required purpose. To determine the efficiency of the method, a recovery study was conducted. This was done by spiking a known concentration of the metals of interest (Fe, Cu, Zn, Co, Ni, Cr, Pb and Cd) into wheat samples prior to digestion and analyzed using after pretreatment and optimized sample digestion (Mitra, 2003). Spike recoveries were calculated According to the following formula:

$$R\% = \frac{\text{amount}(\text{spike} - \text{unspike})}{\text{amount added}} \text{x}100$$

2.10. Nutrition Composition of Wheat

Nutritional composition of the wheat sample were included dry matter (DM), Ash content, crude protein (CP), crude fiber (CF), crude fat or ether extract (EE) and carbohydrate were determined according to standard methods AOAC (association of official agricultural chemists) (2020).

$$\text{Carbohydrate} = 100 - (\text{Ash} + \text{EE} + \text{CF} + \text{CP})$$

2.11. Statistical Analysis

Statistical analysis of data was conducted using IBM SPSS statistics 20. All tests were performed in triplicate and data are expressed as mean ±standard deviation.

3. Results and Discussions

3.1. Determination of Heavy metals in wheat

3.1.1. Calibration of the Instruments

The instrument was calibrated using five series of working standards for each metal of investigated. The working standard solutions of each metal were prepared freshly from 10 mg/L intermediate standard solutions of their respective metals. Concentrations of the working standards, correlation coefficients of the calibration curve and equations for calibration curves of each metal are described in Table 3. Immediately after calibration, sample solutions were aspired to AAS instrument. The obtained values were indicated that the linear correlation coefficient was greater than (> 0.99) which indicated that the concentration of each metal was in a good correlation and linearly fit.

Table 3: Working standard concentration, correlation coefficient and equations of the calibration curves for the determination of metals using AAS

Metal	Concentration of working standard (mg/L)	Correlation coefficient of the calibration curves (R^2)	Equation for calibration curves
Fe	0.5,1,1.5,2,2.5	0.9993	$A = 0.153C - 0.4267$
Zn	0.2,0.25,0.35,0.4,045	0.9959	$A = 6.9391C - 0.3021$
Cr	6,6.5,10,14,16	0.9922	$A = 0.1732C - 01.2356$
Cu	0.11,0.25,0.3,0.35,0.4	0.9958	$A = 5.8738C - 0.57$
Co	0.25,0.5,0.75,1,1.25	0.9913	$A = 0.312C - 0.1522$
Ni	8,10,12,16,18	0.9926	$A = 0.0238C - 0.3189$
Cd	0.1, 0.15, 0.2, 0.25, 0.3	0.9985	$A = 2.03C - 0.0816$
Pb	0.15,0.25,0.35,0.45,0.6	0.9974	$A = 4.2057C - 1.3942$

A=Absorbance, C=Concentrations

3.1.2. Methods of Validation

3.1.2.1. Methods of Detection Limits (MDL) and Quantification Limits (MQL)

MDL is that the minimum amount of analyte which will be measured and reported within 99% confidence level that the analyte concentration is greater than zero (Harris, 1982). In other words, it is the minimum amount of analyte which was distinguished from statistical fluctuations in a blank; usually correspond to the signal of blank and three times the standard deviation of the sample blank (Butcher and Sneddon, 1993). In the present study, five blank samples were digested following an equivalent procedure as the wheat samples and each of the blank samples were analyzed for metal concentrations of Fe, Zn, Cr, Co, Cu, Ni, Pb and Cd by AAS. The standard deviations for each metal were calculated from the five blank triplicate measurements to work out method detection limit of the instrument. Then the method detection limit of each metal was calculated as three times the standard deviation of the blank (3 S_{blank}, n = 15) (Table 4).

MQL is the lowest concentration at which a measurement is quantitatively meaningful. It is also commonly defined as 10 times the signal/noise ratio. If the noise is approximated as the standard deviation of the blank (Sblank), then MQL is 10 × Sblank, n = 15

(Chandravanshi and Adane, 2017; Teressa and Alemyehu, 2017). The results in Table 4 have revealed that both MDL (000576−0.2373) and MQL (0.0192−0791) values were greater than the IDL (0.0010−0.0060); hence, the result of analysis could be reliable.

Table 4: Instrument Detection Limits (IDL), Method Detection Limit (MDL) and Methods Quantification Limit (MQL) for metals of interest determined in wheat samples

Metal	S_{blank}	MDL (mg/L)	MQL (mg/L)	IDL (mg/L)
Fe	0.0791	0.2373	0.791	0.0060
Zn	0.02632	0.07896	0.2632	0.0010
Cr	0.01432	0.04296	0.1432	0.0010
Cu	0.00192	0.00576	0.0192	0.0030
Co	0.0079	0.0237	0.079	0.0050
Ni	0.01581	0.04743	0.1581	0.0010
Cd	0.01581	0.04743	0.1581	0.0020
Pb	0.0421	0.1263	0.421	0.0010

3.2.Recovery Test

Recovery is one of the most commonly used techniques for validation of the analytical results and evaluating how much the method is acceptable for its required purpose. To determine the efficiency of the method, a recovery study was conducted. This was done by spiking a known concentration of the metals of interest (Fe, Cu, Zn, Co, Ni, Cr, Pb and Cd) into wheat samples prior to digestion and analyzed using after pretreatment and optimized sample digestion. Spike recoveries were calculated according to the following formula:

$$R\% = \frac{\text{amount(spike} - \text{unspike)}}{\text{amount added}} \text{x}100$$

Table 5: Recovery test for heavy metal determination in Bura Adele wheat sample (mean±SD, n=3)

Metal	Conc. Unspike ($\bar{X}$ ±SD) (mg/L)	Conc. Spike ($\bar{X}$ ±SD) (mg/L)	Amount added (mg/L)	% Recovery
Fe	0.0907±0.0055	1.818±0.02464	2	86.4
Zn	0.05235±0.003	1.7857±0.005	2	86.7
Cr	0.025±0.002	1.8323±0.009	2	90.4
Cu	0.013±0.001	1.798±0.001	2	89.3
Co	ND	-	-	-
Ni	0.0136±0.0006	1.851±0.01652	2	91.87
Cd	0.0147±0.00153	1.789±0.01	2	88.72
Pb	0.017±0.005	1.892±0.001	2	93.75

ND: not detected

Table 6: Recovery test for heavy metal determination in Keta Berenda wheat sample (mean±SD, n=3)

Metal	Conc. Unspike ($\bar{X}$ ±SD) (mg/L)	Conc. Spike ($\bar{X}$ ±SD) (mg/L)	Amount added (mg/L)	% Recovery
Fe	0.1327±0.012	2.1393±0.015	2	100.33
Zn	0.0647±0.0025	2.0767±0.053	2	100.6
Cr	0.0323±0.004	1.8951±0.003	2	93.14
Cu	0.0117±0.005	1.9867±0.0015	2	98.75
Co	ND	-	-	-
Ni	0.0187±0.0015	1.9193±0.011	2	95.03
Cd	0.0153±0.056	1.9543±0.023	2	95.45
Pb	0.0103±0.003	1.9907±0.007	2	99.02

ND: Not Detected

Table 7: Recovery test for heavy metal determination in Barisa wheat sample (mean±SD, n=3)

Metal	Conc. Unspike ($\bar{X}$ ±SD) (mg/L)	Conc. Spike ($\bar{X}$ ±SD) (mg/L)	Amount added (mg/L)	% Recovery
Fe	0.1367±0.025	1.9737±0.012	2	91.85
Zn	0.1067±0.005	2.1363±0.005	2	101.48
Cr	0.0897±0.0025	1.8647±0.007	2	88.75
Cu	0.0117±0.0021	1.92303±0.0074	2	95.56
Co	ND	-	2	-
Ni	0.1313±0.01	1.9053±0.015	2	88.70
Cd	0.019±0.004	1.937±0.005	2	95.74
Pb	0.025±0.004	1.953±0.0085	2	96.4

The results recovery percentages (%R) of each heavy metal in each wheat sample were explained in (Table 5, 6 and 7) and the mean %R for studied metals in the matrix spike samples ranges between 86.4−101.48%. All these recovery values were within the acceptable ranges of 80-120% for heavy metal analysis (Harvey, 2000). The finding of the study revealed that the proposed method was reliable (Ararso, 2013). Therefore, method of detection limit, method of quantification limit and recovery test was indicated that the proposed technique used for determination of heavy metals in wheat samples was reliable and accurate.

3.3. Concentration of heavy metals in different Wheat samples

Table 8: Average concentration of heavy metals in wheat samples (mean±SD, mg/Kg, n=3)

Metal	Bura Adele wheat sample (mg/kg)	Kete Berenda wheat sample (mg/kg)	Barisa wheat sample (mg/kg)	FAO/WHO limit (2001)
Fe	0.907±0.0055	1.327±0.012	1.367±0.025	425.5
Zn	0.5235±0.003	0.647±0.0025	1.067±0.005	99.4
Cr	0.25±0.002	0.323±0.004	0.897±0.0025	1.3

Cu	0.13±0.001	0.117±0.005	0.117±0.0021	73.3
Co	ND	ND	ND	-
Ni	0.136±0.0006	0.187±0.0015	1.313±0.01	10
Cd	0.147±0.00153	0.153±0.056	0.19±0.004	0.2
Pb	0.17±0.005	0.103±0.003	0.25±0.004	0.3-0.5

ND: not detected

Iron: The highest mean concentration of Fe (1.367±0.025 mg/kg) was observed in Barisa wheat sample. The lowest mean concentration (0.907±0.0055 mg/kg) was found in Bura Adele wheat sample. The concentration of Fe was found to be the highest of among other metals measured in wheat samples. The mean concentration of Fe in this study varies from 0.0907-1.367 mg/kg, which was below the maximum permissible level of 425.5 mg/kg set by FAO/WHO (2001).

Zinc: The mean concentration of Zn in wheat was ranged from 0.523-1.067 mg/kg dry weight. The highest level (1.067±0.005 mg/kg) of Zn was observed in Barisa wheat and the lowest (0.5235±0.003 mg/kg) concentration was found in Bura Adele wheat. The concentration range of Zn (0.523-1.067 mg/kg) in this study was lower than the value (2.98 - 4.79 mg/100 g) reported by Zeleke (2009) and the value (36.3 mg/kg) reported by USDA (2016). The mean concentration of Zn in this study ranges from 0.523-1.067 mg/kg dry weight which was below maximum permissible level 99.4 mg/kg dry weight set by FAO/WHO (2001).

Chromium: The highest mean concentration of Cr (0.897±0.0025 mg/kg) was obtained in Keta Berenda wheat sample. The lowest mean concentration of Cr (0.25±0.002mg/kg) was determined in Bura Adele wheat sample. The mean concentration of Cr in this study ranged from 0.25-0.897 mg/kg, which was below the maximum permissible level of 1.3 mg/kg set by FAO/WHO (2001).

Copper: The concentration of Cu in this study ranged from 0.117 - 0.13 mg/kg dry weight. The highest concentration (0.13±0.001 mg/kg) of Cu was detected in Bura Adele wheat sample and the lowest level (0.117±0.0021 mg/kg) was found in Keta Berenda and Barisa wheat samples. The mean concentration of Cu (5.4 - 45.5 mg/kg) in this study was lower than the value (1.08 - 2.51 mg/100 g) reported by Zeleke (2009) and the value (8.1 mg/kg) reported by USDA (2016). The permissible limit of copper for human consumption recommended by FAO/WHO is 73.3 mg/kg FAO/WHO (2001). The present investigation revealed that the concentration of Cu in each wheat samples was below the maximum permissible limit 73.3 mg/kg for human health set by FAO/WHO (2001).

Cobalt: The level of cobalt in wheat sample of all sample districts was below the method detection limit indicating that there is no Co contamination.

Nickel: The mean concentration of Ni (1.313±0.01 mg/kg) was obtained in Barisa wheat sample. The lowest mean concentration of Ni (0.136±0.0006 mg/kg) was found in Bura Adele wheat sample. The mean concentration of Ni in this study varies from 0.136-1.313 mg/kg, which was below the maximum permissible level of 10 mg/kg set by FAO/WHO (2001).

Cadmium: In this study, the concentration of Cd in wheat ranged from 0.147- 0.19 mg/kg dry weights. The highest (0.19±0.004 mg/kg) concentration of Cd was found in Adele wheat sample and the lowest (0.147±0.00153 mg/kg) concentration of CD was detected in Haramaya wheat sample. The concentration of Cd observed in wheat in this study was below the recommended limit 0.2 mg/kg as set by FAO/WHO (2001).

Lead: In this study, the concentration of lead in wheat ranged from 0.103- 0.25 mg/kg dry weights. The highest (0.25±0.004 mg/kg) concentration of Pb was found in Barisa wheat sample and the lowest (0.103±0.003 mg/kg) concentration of Pb was detected in Keta Berenda wheat sample. The concentration of Pb (0.103 - 0.25 mg/kg) in this study was higher than the value (0.05 mg/100 g) reported by Kibatu, (2017). The concentration of lead observed in wheat in this study was below the recommended limit 0.3 mg/kg as set by FAO/WHO (2001).

3.4.Nutritional Composition of Wheat

The nutritional compositions of each wheat sample are generally explained as averages, however, each wheat are different in chemical composition due to genetic and environmental factors (Metayer *et al*., 1993).

Table 9: Nutritional composition of wheat samples

Sample	Parameters (Mean±SD)					
	%Moisture content	**% Crude fat**	**% Crude Fiber**	**% Ash content**	**% Crude protein**	**% Carbohydrates**
BAW	5.39±0.1607	3.25±01323	8.64±0.0513	1.3±0.1	17.4±0.5	64.05±0.0404
KBW	4.21±0.11	2.95±0.044	7.75±0.05	1.03±0.21	14.4±0.31	69.69±0.1014
BW	3.92±0.0851	3.1±0.0961	8.6±0.2646	1.5±0.153	15.5±0.4042	67.41±0.4444

BAW: Bura Adele Wheat; KBW: Keta Berenda Wheat; BW: Barisa Wheat

The moisture content of BAW (5.39%) was higher than KBW (4.21%) and BW (3.92%) sample (Table 3). Then moisture content of each wheat flour sample was within the acceptable limit of not more than 10% of moisture content which was applicable for long term storage of flour (Singh *et al*., 2005). Moisture content of foods is influenced by type, variety and storage weather condition (Eshun, 2012). The low moisture content of wheat indicated that enhance its storage stability or has higher shelf life by avoiding mould growth and other biological reactions. The moisture content of wheat in this study were range from 3.92%−5.39% and which were quite lower than 5.40%, 7.75% reported by Girmaw and Amare (2021).

The crude fat content of the study showed acceptable levels that were in the range of 2.95% – 3.25% (Table 3). The crude fat content of Bura Adele wheat was higher than KBW and BW sample. The results obtained similar with other finding of fat content ranged from 2.00% –3.50% (Habtamu and Amare, 2021). The fat content of wheat from this study was found to be higher than 1.5% reported for wheat flour (Girmaw and Amare, 2021). The differences in fat content may be due to variable geographical location and variety. A diet which contains high fat content contributes as energy sources for human being. High fat content of Bura Adele wheat in this study was presented better source of fat than the KBW and BW wheat. High fat wheat flours are also good for flavor enhancers and useful in improving palatability of foods in which it is produced (Aiyesanmi *et al*., 1996).

The crude fiber contents of the study showed that Bura Adele wheat (8.64%) has higher crude fiber content than Keta berenda wheat (7.75%) and Barisa wheat (8.6%) respectively (Table 9) and this was presented that Bura Adele wheat sample was a good source of crude fiber content as compared with KBW and BW. The crude fiber content of all of the wheat samples in the study were higher than 0.85% reported by Leach *et al.* (1959). Crude fiber used in the treatment of heart disease, cancer, diabetes and etc.

The ash content of study represents the concentration of mineral found in a nutrition product. The ash content of the wheat ranged between 1.03−1.5% (Table 3). The ash content for BW (1.5%) wheat in this study was higher than the BAW wheat (1.3%) and KBW wheat (1.03%). The ash content (1.27%) of wheat reported by Girmaw and Amare, (2021) was close to 1.5% ash content of wheat reported for these studies. Ash content is an indication of mineral content of a food. Therefore, the finding shows that Barisa wheat samples an important of source minerals than BAW and KBW sample.

The crude protein content of the wheat samples ranges between 14.4− 17.4 % (Table 3). The protein content of wheat reported in this study was found to be lower than the 14.70% (Adams *et al*., 2002) and higher than 12.86% (Moorthy *et al*., 1996) for wheat flours. The crude protein content each sample different from each other due to the geographical location and soil nutrients. The protein content of the wheat in the study useful in food preparation and used as composite especially Bura Adele wheat (17.4%) sample contain higher crude protein content as compared to Barisa wheat (15.5%) and Keta Berenda wheat (14.4%) samples.

The total carbohydrate content of each wheat sample ranges between 64.05−69.69 % (Table 3). The carbohydrate content of all wheat samples the studies were lower than 74.22% reported by Ahmed *et al*. (2012). The study shows that Keta Berenda wheat (69.69%) has higher carbohydrates than Bura Adele wheat (64.05%) and Barisa wheat (67.41%) and Keta Berenda wheat was an important source of energy and used in breakfast preparation. Then carbohydrates are good sources of energy and high concentration carbohydrates desirable in breakfast meals and weaning food preparation.

4. Conclusions and Recommendations

This study has characterized the level of some selected heavy metals (Fe, Zn, Co and Mn) and the proximate nutritional compositions (moisture, ash, fat, fiber, protein and carbohydrate) of wheat samples. The level of these metals and nutritional compositions of wheat cultivated on that area of dodola woreda in a particular area of Bura Adele, Keta Berenda and Barisa was determined; heavy metals was determined by using AAS and proximate nutritional compositions by AOAC method. The results obtained in the study were expressed in terms of mean and standard deviation. The result indicated that the mean concentration of metals (in mg/kg dry weight basis) in wheat samples were found to be from .0907-1.367 mg/kg of Fe, 0.523-1.067 mg/kg of Zn, 0.25-0.897 mg/kg of Cr, 0.117 - 0.13 mg/kg of Cu, 0.136-1.313 mg/kg of Ni, 0.147- 0.19 mg/kg of Cd and 0.103 - 0.25 mg/kg of Pb respectively. However, Co is below the method detection limit. Barisa wheat sample had higher heavy metal contents than other sites due to long term application of pesticides and synthetic chemical fertilizers, additionally due to geographical location of soil and farming system. The nutritional composition of wheat increasing as order of BAW>BW>KBW; therefore, Bura Adele wheat (BAW) has higher nutrition composition than other study area. However, each wheat sample is a good source of Fe, Zn, Cr, Cu, Co, Ni, Cd and Pb, moisture, ash, fat, fiber, protein and carbohydrate content. The concentration each study area was different may be due to long term application of pesticides and chemical fertilizers, storage condition, geographical location of soil and farming conditions. I recommended that further the study required comparing the nutritional composition like carbohydrate, protein, fat and fiber content of wheat with other food crops and also study has been done on the mineral contents of similar variety wheat with the soil analysis from different locations. In addition to selection of heavy metals determination was performed by using ICP-OES instrument such that other researchers must look for this result with other more advanced instruments if there.

5. References

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