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Evaluation of Proximate, Mineral and Anti-nutritional composition of improved and released Common bean varieties in Ethiopia

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Abstract: **Common bean is the most important major food legume which is used either as a source of protein for local consumption or as an export crop for income generating in Ethiopia. The purpose of the present study was to profile, to quantify and to identify the best nutritional value of common bean varieties that grow under Ethiopian agro ecology. Twenty three varieties of common bean were evaluated for this study. The 100 seed weight ranged between 18.03g (Sari-I)- 51.47g (Hirna) and statically they showed significant difference at P <0.05.The longer cooking time was taken by Babile and Batagoni with the value of 74.67 and 93.00 min respectively and the lowest cooking time was taken by Ecab-0081and Fedis with the same value of 29.00min and statically they also showed significant difference at P<0.05.The proximate compositions were varied from 9.33% (Gobirasha) to 10.61% (Ayenew), from 3.52% (Beshbesh) to 4.70% (Omo-95) ,from 0.84% (Sari-I) to 2.86% (Hundane) ,from 4.40% (Beshbesh) to 8.89% (Ufanzik) ,from 18.62% (Gobirasha) to 25.98 (Tinike) ,from 58.21% (hundane) to 66.36% (Gobirasha) for moisture ,total ash ,crude fat, crude fiber, total protein and total carbohydrate respectively. The highest food energy of Ramadan was found to be the lowest with the value of 314.75Kcal/g and the highest for Hirna (336.42Kcal/g) and showed statistically significant different at P<0.05.The phytate concentrations were ranged from 124.63 to 217.44 mg/100g with this value the highest phytate concentration was recorded by SER-119 and the least was noticed by Babile.The mineral compositions were ranged from 612.95(SER-125) to 1488.65mg/100g(Red Wolaita),from 0.18(Ufanzik) to 6.21mg/100g(Red Wolaita), from 18.3(Gobirasha) to 55.62mg/100g(Red wolaita),from 193.71(Ufanzik) to 423.84mg/100g(SER-119), from 4.63(Ufanzik) to 44.51mg/100g(Lehode),from non-detectable (ND) by the instrument (for Waju and Ufanzik) to detectable concentration of 8.58mg/100g (Red Wolaita) and from 0.05 (Ufanzik) to 0.48mg/100g (Babile) for Phosphorous(P), Sodium(Na) ,Magnesium(Mg) ,Potassium (K),Calcium(Ca) ,Iron(Fe) and Zinc(Zn) content respectively.**

Keywords: **Common Bean Varieties; Proximate Composition; Mineral Content; Phytate Content; Food Energy.**

1. INTRODUCTION

Common bean (*Phaseolus vulgaris L.*) is among one of the most important and well-known food legume. It is the second most important the source of human dietary proteins and the third most important source of calories [1-3]. It is considered as “resource poor meat” and is important inexpensive sources of protein, dietary fiber, and starch. It contains almost two to three times more protein than cereals. Because of their high protein and lysine content, they also represent good sources of supplementary protein when added to cereal grains and root crops, which are low in essential amino acids. In addition to protein common beans are good source of dietary fiber, starch [4]. Common Bean is rich in protein, carbohydrate, dietary fiber and is a good source of antioxidants, as well as vitamins and minerals [5, 6]. Animal proteins are better assimilated than vegetable proteins because plant proteins are deficient in sulphur amino acids (methionine and cysteine), and tryptophan. Therefore, a diet that combines protein-containing foods with complementary cereal amino acids is important to gain the complete amino acid pool [7, 8].Beans contain many bioactive substances that play important physiological roles *in vivo*, including, protein digestibility enzyme inhibitors, others types of enzyme inhibitors and fermentable non-digestible oligosaccharides [5] and 9].

In Ethiopia, Common bean (Phaseolus vulgaris L.) is the most important major food legume which is used either as a source of protein for local consumption or as an export crop for generating foreign currency [10]. This crop was introduced to the northern parts of the country around the 16th century [11]. Common bean has a wide range of adaptation and its production is very heterogeneous in terms of ecology, cropping system and agronomic performance. It is one of the most important grain legumes grown in the low lands of Ethiopia particularly in the Central Rift Valley of Ethiopia. Ethiopian smallholder farmers grow white pea beans for export and food type colored beans for house hold consumption. Common beans are important components of crop production in Ethiopia's smallholders' agriculture, providing an economic advantage to smallholder farmers as an alternative source of protein, cash income, and food security. Common bean is often grown as cash crop by small scale farmers and used as a major food legume in many parts of the country where it is consumed in different types of traditional dishes [12].

In the past time, the aim and goal of Ethiopian agricultural research centers were only to release improved bean varieties in terms of high yield or productivity per hectare and, dryness and disease resistance from their plant breeding and crop Protection perspectives. But nowadays, as one of the responsible institute, Ethiopian institutes of Agricultural Research had a plan to profile and document the quality parameters of crop Varieties and Livestock products which are grown in different agro-ecological zones of Ethiopia and Common bean is one of them. Therefore, the purpose of this study is to analyze quality parameters and document quality profile of common bean varieties grown in Ethiopia that enable the researchers, food processors and other end users to get base line information about quality parameter attributes of common bean (Physico-chemical, proximate chemical ,mineral and anti-nutritional composition) in the selection of the appropriate variety for cultivation and food processing from nutritional point of views that compete worldwide market and for further study on common bean varieties grown in Ethiopia for the future.

2. MATERIALS AND METHODS

2.1. Sample Collection and Preparation

Twenty three common bean varieties were used for this study and all these common bean varieties were collected from Rift valley areas (Awash melkassa, Hawassa, Haramaya) of Ethiopian. These were Ayenew ,Babile ,Batagoni ,Beshbesh ,Chercher ,Dursitu ,Ecab-0081 ,Fedise ,Gobirasha ,Haramaya ,Hirna ,Hundane ,Lehode ,Omo-95 ,Remeda ,Red Wolaita ,Sari-I ,SER-119 ,SER-125 ,Tatu ,Tinike ,Ufanzik and Waju.The collected common bean varieties of seeds were cleaned by hand to remove any foreign matters physically damaged bean, bean with damaged seed coat, bean with fade color and undesirable type of shapes. For each variety about 2 kg cleaned and pure seed sample was taken for the study and packed in polyethylene bags.

2.2. Methods of Analysis

2.2.1. Physico-chemical Analysis

2.2.1.1. Hundred seed weight

Randomly selected 100 dry bean seeds were weighed. One hundred seed weight per number of seeds in one hundred grams with triplicate readings were taken and average values of the triplicate were reported [13].

2.2.1.2. Cooking time

Cooking time was determined according to the method of [14] Mattson bean cooking device. Randomly selected beans were soaked for 16 hours (overnight) at 25C^{o} in distilled water. Soaked bean was positioned into each of the cylindrical holes of the cooker so that piercing tip of 90g rod will be in contact with the surface of the beans. The cooker was place into a two (2) liter capacity stainless steel pan containing 1 liter of boiling water. Beans were judged as a cooked when the stainless steel rod passed through the bean. Cooking time was recorded from the time of boiling commenced after immersing the cooker in the pan to the time 50% pierced through. Mean values of triplicate observation was recorded.

2.2.1.3. Number of Non-soakers

Four hundred randomly selected beans seed was weighed and soaked in a beaker in distilled water with times the volume of the grain at 25°C for 16 hours (overnight). The soaking water was drained and the bean was blotted to remove surface water. The non-soakers were picked-up by hand and then counted, and the value was expressed as percentage.

$$NS=\frac{number of bean nonsoakers}{total number of soaked beans} * 100$$ -----------------------------Equation 1

2.2.2. Proximate composition determination

Moisture content, total ash, crude fat, crude fiber and crude protein content were determined by [15] AOAC (2000) official methods of 925.10, 923.03, 920.39, 920.87 and 945.38; respectively.Whereas the difference was taken to determine total carbohydrate content. Percentage of total Carbohydrate content =100 – (Sum of Percentage Moisture, Protein, Fat + and total ash content). Energy value was quantified based on the three groups of nutrients (carbohydrates, fats and proteins). The gross food energy**:** -FE = {(%TC-%CF) x 4} + (%TFx9) +(%TP x4); -Where, FE=Food Energy in Kcal/g, TC = Total Carbohydrate, CF = Crude Fiber, TF = Total Fat and TP = Total Protein.

2.2.2.1. Moisture Content

Empty dishes and their lids (made of porcelain) was dried using drying oven for 1h at 130°C, transferred to the desiccators (with granular silica gel), cooled for 30 min, and weighed. The prepared samples were mixed thoroughly and about 2.000g of fresh samples were transferred to the dried and weighed dishes. The dishes and their contents were placed in the drying oven and dried for 1h at 130°C. Then the dishes and their contents were cooled in desiccators to room temperature and reweighed and triplicates of each sample were determined. The amount of water present in a sample is considered to be equal to the loss of weight after drying the sample to constant weight at a temperature near the boiling point of water.

$$\text{Moisture}(\%) = \frac{(\text{W1}-\text{W2})*100}{\text{SW}}$$ --------------------------------Equation 2

Where, W_1: weight of dish and fresh sample, W_2: weight of dry sample and dish, SW: sample weight

2.2.2.2. Total ash Content

Four (4) grams of well-homogenized common bean flower were measured and put in to a clean crucible of predetermined weight. The sample-containing crucible was placed a muffle furnace, which was adjusted before at 550°C. The samples were ignited until light gray results or to constant weight obtained. Then the sample were removed and Cooled in Desiccator at room temperature and weighted.

$$Ash(\%) = \frac{(W1-W2)*100}{SW}$$ --------------------------------Equation 3

Where, W_1: Weight of ash + crucible after Ashing, W2: Weight of empty crucible S_W: Weight of sample

2.2.2.3. Crude Fat Content

2 gram of common bean flour was weighted into a previously prepared extraction thimble. The mouth of the thimble is plugged with fat free absorbent Cotton wool. The receiver flask of the soxhlet was clean, dried and weighted accurately before the sample introduced into the soxhlet extractor. The apparatus is assemble and filled with petroleum ether (b.p.35-60°C) spirit to half capacity of the volume of the flask before the fat of the sample is extracted. Then the extraction was performed /continued for 4 hours. After completing the time, the extracted fat was removed and then oil/fat containing flasks were attached it to the rotary evaporator to evaporate the major portion of the solvent. Using dry oven evaporate the last traces of the solvent at 103 °C for 30 min. the dried flasks that contains fat was cooled in desiccators and then reweighted.

$$Fat(\%) = \frac{(Wf-W)*100}{SW}$$ ---------------------------------Equation 4

Where, Wf: weight of the receiver flask and fat deposits, W: weight of empty receiver flask only, SW: Weight of sample used.

2.2.2.4. Crude Fiber content

Crude fiber was determined after digesting a known weight of common bean flour by refluxing 1.25% boiling sulfuric acid and 28% boiling potassium hydroxide. About 1.6g of sample was digested into a 600ml beaker, with addition of 200ml of 1.25% H2SO4, and boiled gently exactly for 30 min placing a watch glass over the mouth of the beaker. During boiling, the level of the sample solution was kept constant with hot distilled water. After 30 min boiling, 20ml of 28% KOH was added and boiled gently for a further 30 min, with occasional stirring. Then filtration and washing was performed. Drying and combustion: The crucible with its content was dries for 2 h in an electric drying oven at 130°C and cooled for 30 min in the desiccators (with granular silica gel), and then weighed (recorded as W1). The crucible was transferred to a small muffle furnace and incinerated for 30min at 550°C. The crucible was cooled in the desiccators and weighed (recorded as W2). Then the fiber was calculated as a residue after subtraction of the ash.

$$\text{Crude fiber}\left(\frac{g}{100g}\right) = \left(\frac{W1-W2}{W2}\right) * 100$$ --------------------------------------Equation 5

Where: W1: weight of (Crucible + sample) after drying, W2: weight of (Crucible + sample) after ashing, W3: weight of fresh sample.

2.2.2.5. Crude protein content

The test was performed by Kjeldahl method (AOAC, 2005).0.5gram of common bean flour sample was weighted into 50ml kjeidah flask and added 8 ml of concentrated, H_2S0_4 with one spoon (copper and potassium sulphate) mixture catalyst. Samples were digested until pure colorless solution observed. Then digested samples were distilled by using distillation unit and the distilled vapor gass (Ammonia) were collected with 25 ml of the mixture of 2% boric acid mixed indicator of (bromocresso green plus methyl red). The distilled sample was titrated by 0.1N HCluntil the first appearance of the pink color.

$$CrudeProtien(\%) = \frac{(a*b*14*6.25)*100}{w}$$ ---------------------------------Equation 6

Where; - a = normality of the acid; b = volume of standard acid used (ml), corrected for the blank (i.e., the sample titre minus the blank titre); w = sample weight (g); and 6.25 = conversion factor for protein from % nitrogen.

2.2.2.6. Total Carbohydrate

Total carbohydrate content of the sample was determining as total carbohydrate by difference that was by subtracting measured protein, fat, ash and moisture from 100 % according to method by Onwuliri [16].

$$\text{TC}(\%) = 100 - \{\text{Moisture } (\%) + \text{Protein } (\%) + \text{Fat } (\%) + \text{Ash } (\%)\}$$ ---------------Equation 7

Where, TC= total carbohydrate

2.2.3. Food Energy

The Gross Food Energy:-The value was estimated by the equation**,** Edeoga**[**17]

$$\text{Food Energy } \left(\frac{\text{Kcal}}{g}\right) = \{(\%TC - \%CF) \text{ x } 4\} + (\% \text{ TF x } 9) + (\%CP \text{ x}4)$$ ---------------Equation 8

Where, TC = Total Carbohydrate, CF = Crude Fiber, TF = Total Fat and CP = Crude Protein.

2.2.4. Determination of Anti-nutritional Content

2.2.4.1. Phytate content

Phytate was determined by a sensitive method developed by Haugh and Lantzsch [18]. About 1 g of bean samples was weighed and phytate was extracted with 10 mL of 0.2 NHCl. During the extraction process, the mixture was stirred for 30 min by using a magnetic stirrer. To a 0.5 mL, 1 mL of ammonium iron III sulphate in HCl (0.2 g ammonium iron (III) sulphate 12H2O in 100 mL of 2N HCl and made up to 1 L) was added in the test tube and boiled for 30 min in a boiling water bath and then cooled to room temperature in ice water. The contents of the tube were mixed and centrifuged for 30 min at 3000 rev/min. 1 mL of the supernatant was transferred to another tube and 1.5 mL of 2-2′-bipyridine solution (10 g of 2-2′- bipyridine with 10 mL thioglycolic acid in 1000 mL water) was added. Absorbance of the solution was determined at 519 nm wavelength against distilled water. A standard curve was prepared using phytate-phosphorus at concentration between 3 and 30 µg/mL treated the same way but without the sample. All determinations were done in triplicate.

2.2.5. Determination of Mineral composition

2.2.5.1. Mineral composition

Mineral contents of powder sample were determined by atomic absorption spectrometry/flame photometry according to the methods [19]. For wet digestion of sample, 1g of the powdered sample was taken in digesting glass tube. 12ml of HNO3 was added to the food samples and mixture was kept for overnight at room temperature. Then 4ml perchloric acid (HClO) was added to this mixture and was kept in for the fumes block for digestion. The temperature was increased gradually, starting from 50°C and increasing up to 250-300°C. The digestion completed in about 70-85min as indicated by the appearance of white fumes. The mixture was left to cool down and the contents of the tubes were transferred to 100ml volumetric flasks and the volumes of the contents were made to 100ml with distilled water. The wet digested solution was transferred to plastic bottles labeled accurately. Put the sample in many tube to centrifuge it at 3000rpm to 10min. Use supernatants for mineral determination.

The digested sample was analyzed for mineral contents by Atomic Absorption Spectrophotometer. Different electrode lamps were used for each mineral. The instrument was run for standard solutions of each mineral before and during determination to check that it is working properly. All minerals were performed with dilution factor of 100 except Mg. For determination of Mg, further dilution of the original solution was done by using 0.5ml original solution and enough distilled water is added to it to make the volume up to 100ml. Also for the determination of Calcium, 1.0ml lithium oxide solution is added to the original solution to unmask Calcium from Magnesium. The concentrations of minerals recorded in terms of "ppm" are converted to milligrams (mg) of the minerals by multiplying the ppm with dilution factor and dividing by 1000, as follows:

$$MC=\frac{absorbency*dryweight*D}{Weightofsample*1000}(mg/g) \text{ --------------------------------Equation 9}$$

Where, MC=mineral composition, D = dilution factor

Sodium (Na) and potasium (K) analysis of the sample were done by the method of flame photometry. The same wet digested food sample solutions as used in Atomic Absorption Spectrometry are used for the determination of Na and K. Standard solutions of 20, 40, 60, 80 and 100 milliequivalent/L are used both for Na and K. The calculations for the total mineral intake involve the same procedure as given in Atomic Absorption Spectrometry

2.2.6. Statistical data Analysis

The experimental data were analyzed by means of one-way analysis of variance (ANOVA) and Tukey test ($\alpha = 0.05$) using Statistica software Version 8.0 (StatSoft, Tulsa, OK, USA). Significant differences were considered in all statistical calculations if the P-values were < 0.05. All pair wise comparisons were used for the comparison of means of the result using Tukey's Honestly Significance Difference (HSD) test.

3. RESULTS AND DISCUSSION

3.1. Physico-chemical properties (100 seed weight, cooking time and non-soakers/400seeds)

The mean values of the physico-chemical properties of twenty three common bean varieties, such as 100 seed weight, cooking time and non-soakers per 400g seeds were presented in **table 1.** One hundred seed weight mean value among Hirna (51.47g),Fedise (43.37g) ,Gobirasha (40.82g) ,Lehode (38.26g),Waju (32.74g) ,Haramaya (29.83g),Chercher (26.78g) ,Red Wolaita (22.14g) and Dursitu (18.14g) were found to be statistically different ($p<0.05$). The highest and lowest one hundred seed weight values were recorded by Hirna (51.47g) and Sari-I (18.03g) respectively. Cooking time is one of the main considerations in evaluating quality of crops like pulses. As longer cooking time results in a loss of nutrients and could affect the preference of end users. The lowest cooking time was found in fedis (29min) and the highest for Batagoni (93min). The cooking time among Batagoni (93.00min), Babile (74.67min), Remeda (62min), Haramaya (46.67min) and Fedise (29.00min) was found to be statisticaly significant diffferent ($p<0.05$). No statistical differences were observed regarding cooking time among Haramaya (46.67min), Beshbesh (46.33min) ,Gobirasha (44.67min) ,Chercher (42.33min) , Ayenew (41.00min) ,Tatu (40.33min) ,Lehode (39.33min) ,Omo-95 (39.33min) ,Hundane (38.00min) ,Red Wolaita (37.33min) and Waju (36.33min) ($p<0.05$) as well as among Lehode (39.33min) ,Omo-95 (39.33min) ,Hundane (38.00min) ,Red wolaita (37.33min) ,Waju (36.33) ,Dursitu (35.33min) ,Tinike (31.67min) ,Hirna (31.33min) ,SER-119 (31.33) ,SER-125 (30.00min) ,ECAB-0081 (29.00min) and Fedise (29.00min)($p<0.05$). The shorter cooking time suggests the better nutritional quality and the best customer preference. According to research report of Dereseand Shimelis[20] for five dry bean varieties, the range of cooking time was 24.00min to 35.33min. Furthermore, as reported byShimelis and Rakshit [11], cooking time was within the range of 19.5min to 41.70min for eight dry bean varieties. In the present study with twenty three varieties of dry bean, the cooking time range was almost similar with the previously reported values with the exception of a few varieties. Another physico-chemical quality parameter is Number of non-soakers per 400 seeds (%). Number of non-soakers per 400 seeds (%) amongHirna (4.27%), Lehode (2.33%), Tatu (2.37%), Gobirasha (1.61%), SER-119 (1.03%) and from Ayenew (0.00%) to Waju (0.00%) were statistical significant different from each other ($p<0.05$). The highest number of non-soakers per 400 seeds weight was obtained by Hirna (4.27%) whereas the lowest non-soakers per 400 seeds by Ayenew (0.00%) to Waju (0.00%).

Table 1: physico-chemical properties of improved and released common bean varieties

Varieties	100 seed weight(g)	Cooking time(min)	No of non-soakers/400(%)
Ayenew	37.92 ± 0.54^{de}	$41.00\pm4.00^{d-f}$	0.00 ± 0.00^{g}
Babile	$37.08\pm0.27^{d-f}$	74.67 ± 4.14^{b}	0.00 ± 0.00^{g}
Batagoni	24.59 ± 0.96^{jk}	93.00 ± 2.65^{a}	2.18 ± 0.17^{c}
Beshbesh	24.20 ± 0.67^{kl}	46.33 ± 4.73^{d}	0.00 ± 0.00^{g}
Chercher	26.78 ± 0.19^{j}	42.33 ± 2.52^{de}	0.00 ± 0.00^{g}
Dursitu	18.14 ± 0.29^{m}	$35.53\pm3.05^{e-h}$	1.18 ± 0.18^{ef}
Ecab-0081	$36.78\pm0.67^{d-f}$	29.00 ± 3.00^{h}	0.00 ± 0.00^{g}
Fedise	43.37 ± 0.34^{b}	29.00 ± 4.00^{h}	0.00 ± 0.00^{g}
Gobirash	40.82 ± 1.00^{c}	44.67 ± 3.05^{de}	1.61 ± 0.13^{d}
Haramaya	29.83 ± 1.24^{i}	46.67 ± 3.51^{d}	0.00 ± 0.00^{g}
Hirna	51.47 ± 0.79^{a}	$31.33\pm4.04^{f-h}$	4.27 ± 0.25^{a}
Hundane	35.63 ± 0.97^{gh}	$38.00\pm3.61^{d-h}$	1.23 ± 0.13^{ef}
Lehode	38.26 ± 0.61^{d}	$39.33\pm3.52^{d-h}$	3.33 ± 0.09^{b}
Omo-95	24.16 ± 0.93^{kl}	$39.33\pm2.52^{d-h}$	0.00 ± 0.00^{g}
Remeda	34.06 ± 0.69^{gh}	62.00 ± 2.65^{c}	0.00 ± 0.00^{g}
Red Wolaita	22.14 ± 0.60^{l}	$37.33\pm2.52^{d-h}$	0.00 ± 0.00^{g}
SARI-I	18.03 ± 0.69^{m}	65.00 ± 4.36^{bc}	1.49 ± 0.07^{de}
SER-119	25.00 ± 0.33^{jk}	$31.33\pm1.53^{f-h}$	1.03 ± 0.16^{f}
SER-125	26.70 ± 0.10^{j}	30.00 ± 2.00^{gh}	1.43 ± 0.09^{de}
Tatu	37.69 ± 0.28^{de}	$40.33\pm3.21^{d-g}$	2.37 ± 0.18^{c}
Tinike	34.98 ± 0.87^{fg}	$31.67\pm1.50^{f-h}$	0.00 ± 0.00^{g}
Kufanzik	$35.82\pm1.06^{e-g}$	64.33 ± 4.04^{bc}	0.00 ± 0.00^{g}
Wajo	32.74 ± 0.58^{h}	$36.33\pm4.04^{d-h}$	0.00 ± 0.00^{g}
Grand mean	**31.92**	**44.71**	**0.88**
CV	**2.22**	**7.46**	**11.52**
HSD at α=0.05	**2.22**	**10.45**	**0.32**

Means within same column followed by the same letters are not significantly different;(P>0.05); All values are mean ± SD of three independent determinations, CV=Cofficient of variance

3.2. Proximate Composition Determination

The proximate compositions (moisture content, total ash, crude fat, crude fiber, total protein and total carbohydrate) of twenty three common bean varieties in the study were presented in **table 2** whereas grand mean values of proximate chemical composition of twenty three improved and released common bean varieties were described on **figure1**.

3.2.1. Moisture Content

The moisture content was measured in order to know the amount of water present in each variety, it is important in terms of productivity. The high moisture content suggested that they should be dried properly before storage so as to avoid the invasion of micro-organisms which can lead to their spoilage [21]**.** In this study**,**the mean value of moisture content of Ayenew was found to be the highest with the value of 10.62% and was significantly different ($p<0.05$) from ECAB-0081 and Goberasha with the mean value of 9.97% and 9.33% respectively. There were statistically the same ($p>0.05$) in moisture content among Ecab-0081(9.97%),SER-119 (9.95%),Beshbesh (9.84%),SER-125 (9.81%),SARI-I (9.74%),Kufanzik (9.74%),Batagoni (9.69%),Chercher (9.67%),Tinike (9.61%),Haramaya (9.54%),Hirna (9.53%) ,Red Wolaita (9.36%) and Gobirasha (9.33%).The moisture content of Babile and Hundane were recorded with the same value of 10.35±0.09 % and 10.35±0.01% respectively. But there was statistically difference ($p<0.05$) between Babile (10.35%) and Batagoni (9.69%).On the other hand the mean moisture content of Ayenew,Waju,Tatu, Fedis,Dursitu,Omo-95, Remeda ,Babile ,Hundane ,Lehode and Ecab-0081 with value of 10.62±0.37%,10.60±0.06% ,10±0.02% ,10.53±0.05% ,10.53±0.03%,10.45±0.09%,10.45±0.11% ,10.350.09% ,10.35±0.04% ,10.13±0.34% and 9.97±0.06% respectively which showed statistically the same($p>0.05$) (**table 2**). According to the report of research done by Derese and Shimelis[20] and Shimelis and Rakshit [11], Moisture content concentration varied from 10.13 to 10.27 g/100g (DM) and 9.08 to 11.01g/100g (DM) respectively.

3.2.2. Total ash content

Ash is a part of the proximate composition and is related to mineral residue. The level of ash content represents total inorganic matters that are located in food ingredients. The highest value of total ash in this study was recorded by Omo-95 (4.70%) while the lowest value was by Beshbesh (3.52%). The statistical differences were observed in total ash content among Omo-95, Lehode, Red Wolaita and Beshbesh with the value of 4.70±0.05%, 4.34±0.06%, 3.94±0.12% and 3.52±0.34% respectively($p<0.05$).The total ash content among Babile (4.08%),Chercher (4.06%),Tinike (4.06%),Gobirasha (4.04%),Haramaya (3.96%),Hirna (3.94%),Red Wolaita(3.94%),Ayenew (3.84%),Hundane(3.83%), Ecab-0081 (3.81%),Tatu (3.79%) and Batagoni (3.77%) were statistically similar. Dursitu had total ash content with the value of 4.52% which was significantly different ($p<0.05$) from Gobirasha (4.04%) and Beshbesh (3.52%). The total ash content of 23 common bean varieties ranged between 3.52% of Beshbesh and 4.70% of Omo-95 (**table2**).Those common bean varieties showed a relatively high ash content. While trait variation was greater than 2.86 and 4.26 g/100g reported by Shimelis and Rakshit [11] and lower than 4.60 and 5.00 g/100g [22] [23, it was narrower and lower than 3.00 and 6.00 g/100g as demonstrated by Kaur [24].

3.2.3. Crude fat or Lipid content

The ether extract fractions (crude fat or lipid) provides a very good source of energy and has a great role in transport of fat soluble vitamins, insulates and protects internal tissues and contributes to important cells processes [21,25]. Based on this study, Hudane had the highest crude fat among the others with the value of 2.86±0.22%. No statistical differences in crude fat content were obtained among most of the common bean varieties under the study such as Ser-119 (1.41%),Ramadan (1.39%) ,Dursitu (1.38%) ,Kufanzic (1.38%) ,Lehode (1.38%) ,Babile (1.35%) ,Ser-125 (1.20%) ,Waju (1.16%) ,Beshbesh (1.15%) ,Red Wolaita (1.11%) ,ECAB-0081 (1.10%) ,Tinike (1.09%) ,Fedise (1.09%) ,Haramaya (1.05%) ,Tatu (0.99%) ,Omo-95 (0.87%) and SARI-I (0.84%) ($p>0.05$).Sari-I was found to be the lowest crude fat content. The crude fat content of Hundane (2.86%) was statistically different from Hirna (2.17%) and Batagoni (1.46%) ($p<0.05$).Crude fat or total lipid mean values of twenty three common bean varieties ranged between 0.84% and 2.86% for the Sari-I and Hundane, respectively (**table 2**). Lipid content of those common bean varieties were lower than 2.45 to 3.62 g range reported by Bhatty [22] and Siddiq [23]. Moreover, those Ethiopian common bean varieties showed relatively high fat content when compared with 0.60 to 2.38 g reported by several other laboratories [26] [27] [11] [24].

3.2.4. Crude fiber content

Crude fiber is also one of the components of proximate composition that indicate the quality parameter of food.The percentage of the crude fiber suggested that diet prepared with common beans could help to ensure good gut movement of food through the gut to provide energy and ensure break down of the food. Moreover crude fiber is known to influence production of high butyrate levels and butyrate has been linked to lower risks for cancer [28]. Ufanzik (8.89%) had the highest crude fiber content while Beshbesh (4.40%) had the lowest value in this research work. The statistical difference was observed among Kufanzik (8.89%), SARI-I (7.82%), Dursitu (6.66%), SER-125 (5.49%) and Beshbesh (4.40%) but no statistical difference between Kufanzik (8.89%) and Ramadan (8.49%) ($p<0.05$). No statistical differences were noticed among Fedise,Omo-95,Tinike ,Gobirasha ,Babile ,Red Wolaita ,SER-125 ,Chercher ,Ayenew and Batagoni with the crude fiber mean value of 6.245% ,6.23% ,5.95% ,5.86% ,5.69% ,5.58% ,5.49% ,5.39%,5.32% and 5.26% respectively(**table 2**).The crude fiber content of those twenty three common bean varieties were in the range of 4.40% to 8.89% which showed relatively high when compared with Crude fiber reported by Derese [20] and Shimelis [11] were ranged from 4.86g/100g to 7.01g/100(DM) and 4.66 to 5.95 g/100g (DM) respectively. This result indicates that proximate composition varied from variety to variety.

3.2.5. Crude Protein content

Protein is another part of proximate composition which is the second dominant in percentage after carbohydrate that help in physical and mental growth and development as earlier reported by [29, 30]. Among twenty three Ethiopian improved and released common bean varieties, the highest and lowest crude protein content was obtained by Tinike (25.98%) and Gobirasha (18.62%) respectively. The crude protein mean content of Tinike (25.98%) was statistically different from that of mean crude protein content of Chercher (22.74%) and Kufanzik (19.59%) and also statistically different from Beshbesh (21.43%)($p<0.05$). The crude protein content of Tinike (25.98%), Babile (25.83%), Dursitu (24.83%), Hundane (24.75%), Waju (24.62%), Omo-95 (24.50%), SARI-I (24.35%), Haramaya (24.03%), Ayenew (23.61%) and Red Wolaita (23.52%) were statistically the same ($p>0.05$). Similarly, there were no statistical differences in crude protein content among Chercher (22.74%), Fedise (22.39%), SER-125 (22.33%), SER-119(22.08%), Lehode(21.92%), Hirna(21.71%), Remeda(21.66%), Beshbesh(21.43%), Batagoni (21.24%),Tatu (20.70%) and ECAB-0081 (20.34%).Also the statistical difference between Kufanzik (19.59%) and Gobirasha (18.62%) were the same($p>0.05$). The total protein mean content of twenty three improved and released common bean varieties were in the range of 18.62% (Gobirasha)-25.98% (Tinike) (**Table 2**) which was greater than 17.96g/100g to 22.07g/100g for the improved Ethiopian beans [11] and was lower than protein content obtained from the Portuguese beans [24] with 30.7g/100g and the Iberian Peninsula beans [23] with 31.4g/100g bean collections. Madeira Island types/varieties have been reported protein content ranging from 18.55 to 29.69 g/100 g [27]. The protein mean content of beans also reported in the range of 20.43 to 23.62 g/100g by [22, 23].

3.2.6. Total carbohydrate Content

Carbohydrate is the first dominant part of proximate composition that has agreat role in providing good source of energy as reported in the literature by [29,30]. In this study, the total Carbohydrate content of Gobirasha (66.36%) was found to be the highest. On the other hand Hundane had the lowest total carbohydrate content with the mean value of 58.21%. The Significance differences in total carbohydrate content among Gobirasha (66.36%), Ufanzik (65.58%), ECAB-0081 (64.79%), Beshbesh (64.06%), Tatu (63.95%) and Batagoni (63.84%) were the same ($p>0.05$). But there was significance difference between Gobirasha and Hirna (62.64%), Batagoni and Chercher (59.56%), Chercher (61.17%) and Babile (58.39%) in total carbohydrate content ($p<0.05$).The mean value of total carbohydrate among Sari-I (60.48%),Ayenew (59.58%),Omo-95 (59.48%),Tinike (59.26%),Waju(59.08%%),dursitu (58.75%),babile (58.39%) and Hundane (58.21%) were not significantly different. Twenty three Ethiopian improved and released common bean varieties have found the total carbohydrate mean content in the range of 58.21%-66.36% (**Table 2)** which was lower than average carbohydrate content reported by [32] with value of 69.89 to 72.47g/100g and had comparable carbohydrate content cited by [11] and [33] with the value of 62.05 to 65.08g/100g and 62.85 to 66.20g/100g respectively.

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Table 2: Proximate chemical composition of improved and released common bean varieties

Varieties	Moisture (%)	Total ash (%)	Crude fat (%)	Crude fiber (%)	Total protein (%)	Total Carbohydrate (%)
Ayenew	10.62±0.37^{a}	3.84±0.08^{g-j}	2.36±0.33^{ab}	5.32±0.26^{h-k}	23.61±1.12^{a-f}	59.58±1.03^{f-i}
Babile	10.35 ±0.09^{a-e}	4.08±0.04^{d-h}	1.35±0.20^{d-f}	5.69±0.37^{k}	25.83±0.23^{a}	58.39±0.13^{i}
Batagoni	9.69±0.21^{f-h}	3.77±0.15^{h-j}	1.46±0.21^{de}	5.26±0.25^{h-k}	21.25±0.74^{f-h}	63.842±0.45^{a-d}
Beshibesh	9.84±0.62^{d-h}	3.52±0.34^{j}	1.15±0.12^{d-f}	4.40±0.04^{g-j}	21.43±0.69^{f-h}	64.06±0.63^{a-c}
Cherecher	9.67±0.16^{f-h}	4.06±0.05^{d-h}	2.36±0.20^{ab}	5.39±0.27^{h-k}	22.74±0.63^{b-g}	61.17±0.56^{e-h}
Dursitu	10.52±0.03^{a-c}	4.53±0.17^{a-c}	1.38±0.10^{d-f}	6.66±0.35^{d-g}	24.83±0.87^{ab}	58.75±0.63^{hi}
ECAB-0081	9.97±0.06^{b-g}	3.81±0.04^{g-j}	1.10±0.21^{d-f}	7.24±0.25^{c-e}	20.34±1.28^{g-i}	64.78±1.25^{ab}
Fedise	10.53±0.05^{a-c}	4.33±0.03^{b-d}	1.09±0.19^{d-f}	6.24±0.24^{e-h}	22.39±1.17^{b-g}	61.66±1.45^{c-g}
Gobe Rash	9.33±0.29^{h}	4.04±0.08^{d-i}	1.64±0.20^{cd}	5.86±0.21^{f-i}	18.62±0.22^{i}	66.37±0.62^{a}
Haramaya	9.53±0.09 $^{f-h}$	3.96±0.06^{e-i}	1.05±0.14^{ef}	5.03±0.07^{i-k}	24.03±1.17^{a-e}	61.43±1.05^{d-g}
Hirna	9.53±0.09^{f-h}	3.94±0.07^{e-i}	2.17±0.30^{bc}	5.13±0.34^{i-k}	21.71±0.70^{e-h}	62.64±0.99^{b-e}
Hundane	10.35±0.04^{a-e}	3.83±0.15^{g-j}	2.86±0.22^{a}	6.81±0.30^{c-f}	24.75±0.67^{ab}	58.22±0.49^{i}
Lehode	10.13±0.34^{a-f}	4.34±0.06^{b-d}	1.56±0.23^{d-f}	4.68±0.28^{jk}	21.92±0.27^{d-h}	62.25±0.40^{b-e}
Omo-95	10.45±0.09^{a-d}	4.70±0.05^{a}	0.86±0.08^{f}	6.23±0.24^{e-h}	24.50±0.82^{a-c}	59.48±0.95^{f-i}
Remeda	10.45±0.11^{a-d}	4.12±0.10^{d-g}	1.39±0.13^{d-f}	8.49±0.88^{ab}	21.66±1.14 $^{e-h}$	62.38±1.05^{b-e}
Red Wolaita	9.36±0.20^{gh}	3.94±0.12^{f-i}	1.11±0.10^{d-f}	5.58±0.03^{h-j}	23.52±0.81^{a-f}	62.08±1.07^{c-f}
SARI-I	9.74±0.14^{e-h}	4.59±0.03^{ab}	0.84±0.15^{f}	7.82±0.27^{bc}	24.35±0.85^{a-d}	60.48±0.87^{e-i}
SER-119	9.95±0.04^{c-h}	4.22±0.10^{c-f}	1.41±0.18^{d-f}	6.80±0.21^{c-f}	22.08±0.48^{c-h}	62.35±0.32^{b-e}
SER-125	9.81±0.04^{e-h}	4.27±0.0^{b-e}	1.19±0.18^{d-f}	5.49±0.36^{h-j}	22.33±0.58^{b-g}	62.40±0.61^{b-e}
Tatu	10.57±0.02^{a-c}	3.79±0.02^{g-j}	0.99±0.10^{ef}	6.77±0.24^{d-f}	20.702±1.00^{g-i}	63.95±0.70^{a-d}
Tinike	9.61±0.15^{f-h}	4.06±0.07^{d-h}	1.09±0.22^{d-f}	5.95±0.18^{f-i}	25.98±0.51^{a}	59.26±0.31^{g-i}
Kufanzik	9.74±0.31^{e-h}	3.72±0.03^{ij}	1.38±0.11^{d-f}	8.89±0.59^{a}	19.59±0.91^{hi}	65.57±0.71^{a}
Wajo	10.60±0.06^{ab}	4.55±0.05^{ab}	1.15±0.13^{d-f}	7.29±0.25^{cd}	24.62±0.65^{a-c}	59.08±0.71^{g-i}
Grand Mean	**10.02**	**4.09**	**1.42**	**6.22**	**22.73**	**61.75**
CV	**2.02**	**2.62**	**12.96**	**5.30**	**3.60**	**1.34**
HSD at α=0.05	**0.64**	**0.34**	**0.58**	**1.03**	**2.56**	**2.59**

All values are mean ± SD of three independent determinations; Means within same column followed by the same letters are not significantly different (P> 0.05). SD=Standard Deviation, HSD=Honestly Significance Difference, CV=Cofficient of variance

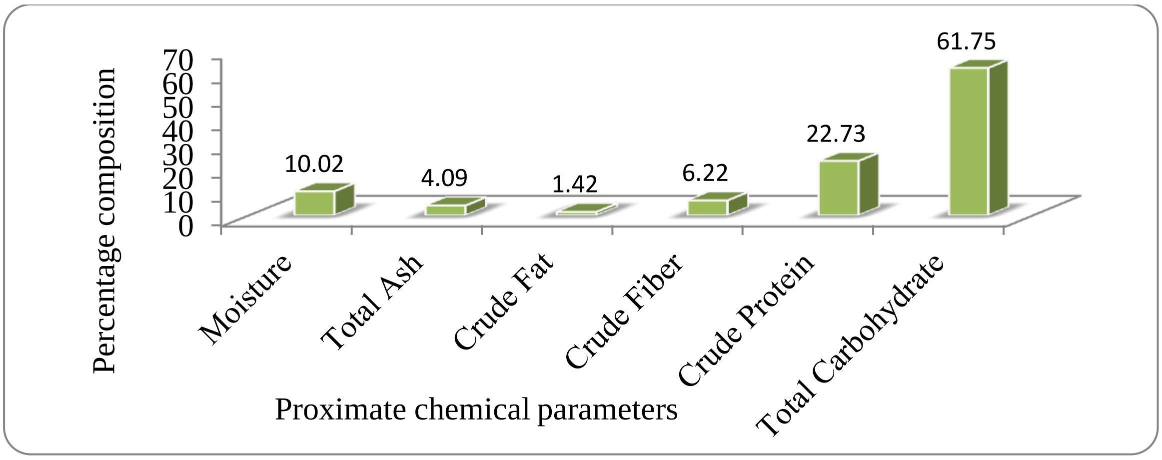

Figure 1: Grand mean values of proximate chemical composition of twenty three improved and released common bean varieties

3.3. Anti-nutritional Content

3.3.1. Phytate/phytic acid content

Phytochemicals can reduce the nutritional values of beans by limiting the digestibility of proteins and carbohydrates (e.g., enzyme inhibitors, lectins and tannins) or by reducing the biological availability of minerals [34]. Phytate/Phytic acid is one of component of phytochemical that is widely distributed in legume seeds and it accounts for about 78% of the totalphosphorus in pulses [35]. Phytic acid binds trace/micro elements (Fe,Zn ,Cu,Mn, B) and macro elements (Ca ,Mg ,P,Na,K) in the gastrointestinal tract are makingdietary minerals unavailable for absorption and utilization by the body [36,37]. It can also formcomplexes with proteins, proteases and amylases of the intestinal tract, thus inhibitingproteolysis [38]. In this study**,** as indicated in the table 3 the Maximum phytate content was obtained by Babile (217.44mg/100g) and the minimum phytate content was recorded by SER-119 (124.63mg/100g). The Phytate content among Babile ,Fedise ,Chercher ,Ayenew ,ECAB-0081,Ramadan,Batagoni,SARI- I,Waju,Dursitu,Ufanzik and Red Wolaita with the mean value of 217.44 mg/100g ,205.92 mg/100g ,199.46mg/100g ,189.94mg/100g ,179.68mg/100g,171.76mg/100g ,165.75 mg/100g ,160.38 mg/100g ,153.71 mg/100g ,148.57 mg/100g ,142.02 mg/100g and 126.95 mg/100g were showed statistically different respectively ($p<0.05$). But, there were no statistical differences among Remeda (171.76mg/100g), Lehode (171.76mg/100g), Gobirasha (169.89mg/100g) and Omo-95 (169.06mg/100g) ($p>0.05$).The statistical difference between Babile(217.44mg/100g) and Tatu (217.17mg/100g),Fedise (205.92mg/100g) and Beshbesh (202.06mg/100g),Ramadan (171.76mg/100g) and Lehode (171.45mg/100g), Haramaya (149.44mg/100g) and Waju (153.71mg/100g),SER-125 (146.26mg/100g) and Kufanzik (142.02mg/100g), Red Wolaita (126.95mg/100g) and SER-119 (124.63mg/100g),ECAB-0081 (179.68mg/100g) and Hundane (177.83mg/100g) were similar respectively($p>0.05$).The phytate mean content of twenty three common bean varieties were in the range of 124.63mg/100g (SER-119) to 217.44mg/100g (Babile) that were lower than phytate composition reported by Derese[20] for five common bean varieties ranged from 13.51 to 23.76mg/g.

Table 3: Phytate content of improved and released common bean varieties

Varieties	Phytate(mg/100g)	Varieties	Phytate(mg/100g)
Ayenew	189.94 ± 0.99^{d}	Lehode	171.45 ± 0.92^{f}
Babile	217.44 ± 0.81^{a}	Omo-95	169.06 ± 2.17^{fg}
Batagonia	165.75 ± 1.33^{gh}	Remeda	171.76 ± 0.46^{f}
Beshbesh	202.06 ± 2.36^{bc}	Red wolaita	126.95 ± 1.81^{m}
Chercher	199.46 ± 0.89^{c}	Sari-I	160.38 ± 0.98^{i}
Dursitu	148.57 ± 1.26^{k}	SER-119	124.63 ± 0.82^{m}
Ecab-0081	179.68 ± 3.25^{e}	SER-125	146.26 ± 0.88^{kl}
Fedis	205.92 ± 1.60^{b}	Tatu	217.17 ± 1.00^{a}
Gobirasha	169.89 ± 1.30^{fg}	Tinike	160.07 ± 1.76^{i}
Haramaya	149.44 ± 0.91^{jk}	Kufanzik	142.02 ± 1.63^{l}
Hirna	164.27 ± 1.05^{hi}	Waju	153.71 ± 1.73^{j}
Hundane	177.83 ± 1.78^{e}		
Grand Mean	**170.16**		
CV	**0.89**		
HSD at α=0.05	**4.73**		

Values within the same superscript letters are significantly different from each other ($P < 0.05$); All values are mean ± SD. SD=Standard Deviation, HSD=Honestly Significance Difference, CV=Cofficient of variance

3.4. Mineral Content and Food Energy

3.4.1. Macronutrient content (P,Na,K,Mg and Ca)

Macronutrients analyzed in this study are the most important minerals from the dietary perspective as they play vital functions in the organism [39].The maximum phosphorous (P) content was obtained by Red Wolaita with the value of 1488.65 mg/100g whereas the minimum value by SER-125(612.97mg/100g). Babile, Dursitu and Tinike had the same phosphorous content (840mg/100g). Ufanzik had the lowest Sodium (Na) content with the value of 0.18mg/100g compared to the remaining common bean varieties and Red Wolaita (6.21mg/100g) had the highest Sodium (Na) content. Magnesium (Mg) content of Red Wolaita (55.62mg/100g) was the highest value among the others whereas magnesium (Mg) content of Gobirasha (18.3mg/100g) was the lowest value. Similarly, the highest Potasium (K) content was noticed in SER-119 (423.84mg/100g) and the lowest value for Ufanzik (193.71mg/100g). On the other hand, the lowest and highest Calcium (Ca) content was recorded by Kufanzik (4.63mg/100g) and Lehode (44.51mg/100g) respectively (**Table 4**). According to research report by Derese[20], the range of phosphorous content, Sodium content, potassium and calcium content were from 273.8 to 762.4 mg/kg, from 33.90-39.550 mg/kg, from 17611 to 19805mg/kg and 633.0 to 912.0 mg/kg for five common bean varieties of Ethiopia respectively. In addition to this,the range of phosphorous content and calcium content for eight Ethiopian improved common bean varieties were also reported by Shimelis and Rakshit [11] which were found to be from 147.98 to 173.99 mg/kg and from 731.93 to 1929.77 mg/kg respectively. The Calcium concentrations in beans might have a great influence on cooking time.Varieties having lower calcium content revealed short cooking time.

3.4.2. Micronutrient content (Fe and Zn)

Among micronutrients playing important functions in the organism [39], Fe and Zn were analyzed in this study. The iron (Fe) content of both Fedise and Ufanzik were not detected by the instrument due to very small amount of iron content within them. The first two lowest iron (Fe) content was obtained by Wajo (0.01mg/100g) and Gobirasha (0.02mg/100g).The highest iron (Fe) content was recorded by Red Wolaita with value of 8.58 mg/100g. Babile (0.48mg/100g) had the highest Zinc (Zn) content among the others and Ufanzik had the lowest zinc content with value of 0.05mg/100g (**Table 4**). Range of Iron content was from 61.81 to 83.99mg/kg and zinc content from 15.36 to 28.22mg/kg according research report by Shimelis and Rakshit[11]. Similarly the ranges of these results were also reported byDerese and shimelis [20] from 46.80 to 72.40mg/kg and from 14.30 to 22.90mg/kg for iron and Zinc content respectively.

Table 4: Mineral composition of improved and released common bean varieties

Varieties	P(mg/100g)	Na(mg/100g)	Mg(mg/100g)	K(mg/100g)	Ca(mg/100g)	Fe(mg/100g)	Zn(mg/100g)
Ayenew	580.54	4.18	26.93	201.52	7.01	0.85	0.24
Babile	840	3.99	30.51	275.79	24.29	3.46	0.48
Batagonia	656.22	4.8	19.18	186.81	6.93	1.07	0.16
Beshbesh	818.38	4.57	24.78	217.57	9.4	0.2	0.08
Chercher	688.65	4.14	23.3	195.13	7.19	0.33	0.2
Dursitu	840	4.53	21.29	202.68	5.8	0.14	0.15
Ecab-0081	721.08	4.07	21.5	228.63	6.69	0.12	0.13
Fedise	1304.86	4.15	20.54	210.3	11.36	ND	0.04
Gobirasha	721.08	4.33	18.3	202.09	7.45	0.02	0.17
Haramaya	645.41	4.03	20.82	201.23	8.19	1.13	0.13
Hirna	861.62	3.96	21.73	198.34	6.08	1.64	0.15
Hundane	1715.68	4.56	22.75	234.09	9.84	1.49	0.37
Lehode	1229.19	3.01	36.91	378.69	44.51	4.31	0.41
Omo-95	677.84	4.22	19.34	204.46	10.45	4.73	0.14
Ramadan	1369.73	2.06	22.43	207.77	11.97	1.56	0.11
Red wolaita	1488.65	6.21	55.63	420.4	11.04	8.58	1.4
Sari-I	872.43	4.25	20.7	211.62	6.13	0.39	0.17
SER-119	1283.24	3.25	54.14	423.84	24.51	7.18	0.47
SER-125	612.97	3.52	18.38	221.7	23.87	0.93	0.1
Tatu	850.81	3.87	21.85	215.82	7.99	0.69	0.16
Tinike	840	8.71	26.46	226.85	4.84	0.54	0.26
Kufanzik	688.65	0.18	18.5	193.71	4.63	ND	0.05
Waju	1067.03	3.9	24.74	220.1	8.4	0.01	0.13

3.4.3. Food Energy

Based on this study, the highest food energy mean value was recorded by Hirna (336.42 Kcal/g) whereas the lowest food energy mean value was obtained by Remenda (314.75Kcal/g). No statistical differences were observed among Hirna, Chercher, Beshbesh, Ayenew, Batagoni, Gobirasha and Haramaya in food energy value of 336.42±0.33 Kcal/g, 335.29±2.51 Kcal/g, 334.71±3.17 Kcal/g,332.71±2.05 Kcal/g,332.43±0.39 Kcal/g,331.27±1.28 Kcal/g and 331.11±0.42 Kcal/g respectively(p>0.05). Similarly, the statistical differences among Gobirasha (331.27 Kcal/g), Haramaya (331.11 Kcal/g), Hundane (330.20 Kcal/g), Lehode (330.05 Kcal/g), Red Wolaita (330.05 Kcal/g), SER-125 (327.70 Kcal/g), Tinike (326.93 Kcal/g) and Babile (326.28 Kcal/g) were not significant. Energy values were ranged from 1320.01–1375.74 kJ/100 g (DM) and 1348-1404 KJ/100g for eight and five common bean varieties according to research reported by Shimelis [11] and Derese [20] respectively.

Table 5: Food energy/value of improved and released common bean varieties

Varieties	FE(Kcal/g)	Varieties	FE(Kcal/g)
Ayenew	$332.71 \pm 2.05^{a\text{-}c}$	Lehodo	$330.20 \pm 1.83^{b\text{-}d}$
Babile	$326.28 \pm 2.29^{d\text{-}f}$	Omo-95	$318.78 \pm 0.90^{g\text{-}h}$
Batagoni	$332.43 \pm 0.39^{a\text{-}c}$	Remeda	314.75 ± 3.78^{k}
Beshibesh	334.71 ± 3.17^{ab}	Red Wolaita	$330.05 \pm 1.16^{b\text{-}d}$
Chercher	335.29 ± 2.51^{ab}	SARI-I	315.52 ± 0.33^{jk}
Dursitu	$320.08 \pm 1.35^{g\text{-}h}$	SER-119	$323.23 \pm 1.32^{e\text{-}g}$
ECAB-0081	$321.40 \pm 1.06^{f\text{-}h}$	SER-125	$327.7 \pm 0.83^{c\text{-}e}$
Fedise	$321.03 \pm 1.45^{f\text{-}i}$	Tatu	$320.50 \pm 0.75^{g\text{-}j}$
GobiRash	$331.27 \pm 1.28^{a\text{-}d}$	Tinike	326.93 ± 1.77^{de}
Haramaya	$331.11 \pm 0.42^{a\text{-}d}$	Kufanzik	$317.48 \pm 2.29^{h\text{-}k}$
Hirna	336.42 ± 0.33^{a}	Waju	$315.99 \pm 0.63^{i\text{-}k}$
Hundane	$330.31 \pm 1.49^{b\text{-}d}$		
Grand mean	**325.84**		
CV	**0.52**		
HSD at α=0.05	**5.34**		

Means having different superscript letters are significantly different from each other (P < 0.05); All values are mean ± SD. SD=Standard Deviation, HSD=Honestly Significance Difference.CV=Cofficient of variance

4. CONCLUSION AND RECCOMANDATION

This study has information on the physico-chemical, proximate composition, anti-nutritional and minerals content of 23 Ethiopian common bean varieties. The physico-chemical quality parameter was found to be with the average value of 31.92g, 44.71min and 0.88% for 100 seed weight, Cooking time and number of non saokers respectively. Proximate composition such as moisture, ash, crude fat, crude fiber, crude protein and total carbohydrates of common bean varieties were found with the average value of 10.02%, 4.09 %, 1.42%, 6.22%, 22.73%, and 61.75% % respectively. 170.16mg/100g was the average value of phytate content and average value for food energy was found to be 325.84Kcal/g.The highest value of potassium (1488.55mg/100g), sodium (6.21mg/100g),magnesium (55.62mg/100g) and iron(8.58mg/100g) content were recorded by Red Wolaita variety whereas potassium (423.84mg/100g),calcium (44.51mg/100g) and zinc (0.48mg/100g) content by SER-119,Lehode and Babile respectively. Among the varieties, SER-119 showed the least phytate content. Low phytate content of beans enhances the availability of minerals and digestibility of proteins in the gut. However, variety Tinike and Babile had high value in terms of protein as compared to among the rest varieties. Some of these common bean varieties can be chosen for incorporation in weaning food mixtures and supplementary bean-based processed foods including fortified products, which might be used as an alternative to minimize the critical gap and the problem malnutrition in the country. Besides to this, this study will be used for the selection of appropriate varieties for food processing from nutritional point of views that try to win worldwide market and for further study on common bean varieties grown in Ethiopia for the future.

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CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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